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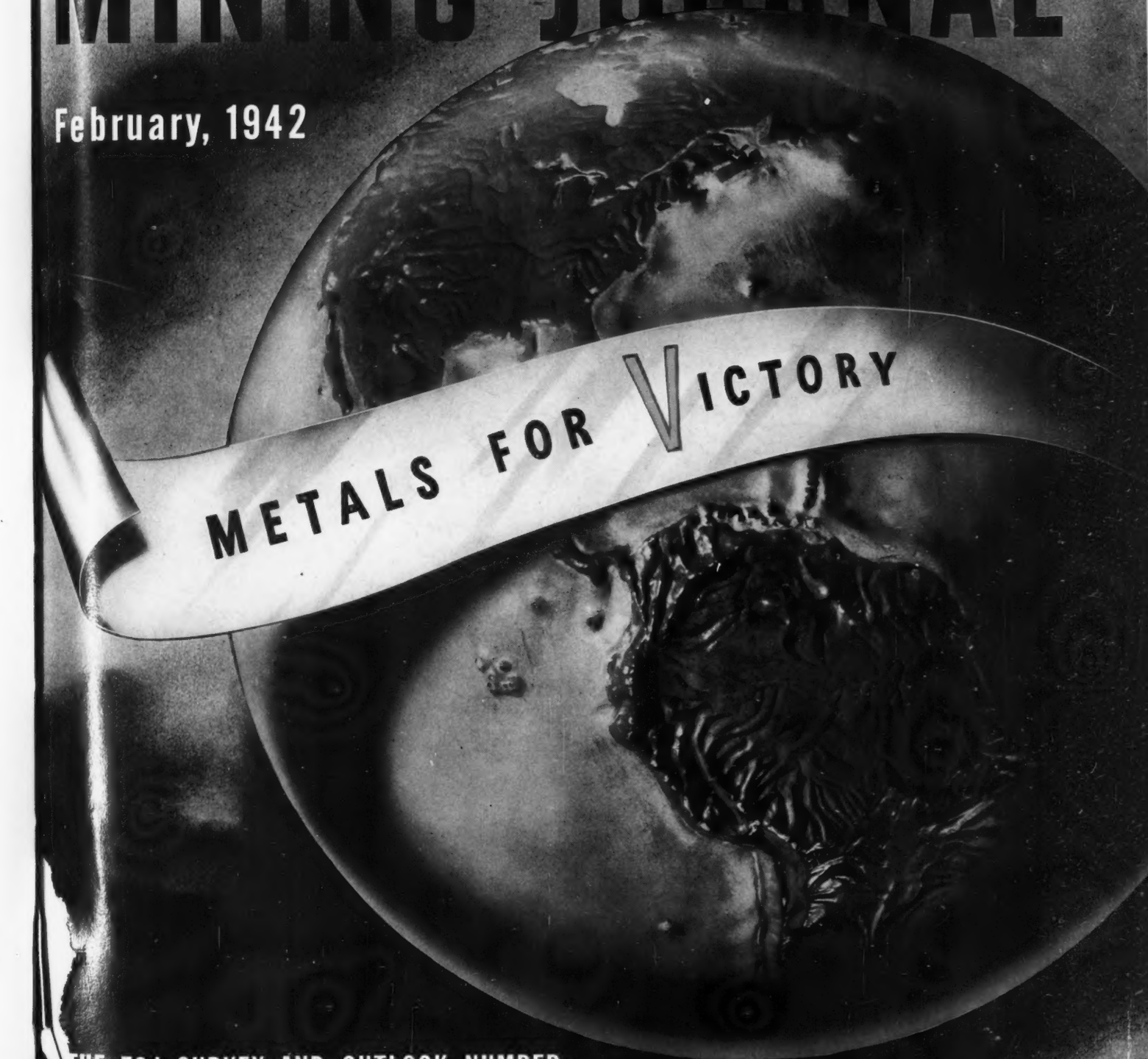
ENGINEERING AND MINING JOURNAL

FEB 19 1942

February, 1942

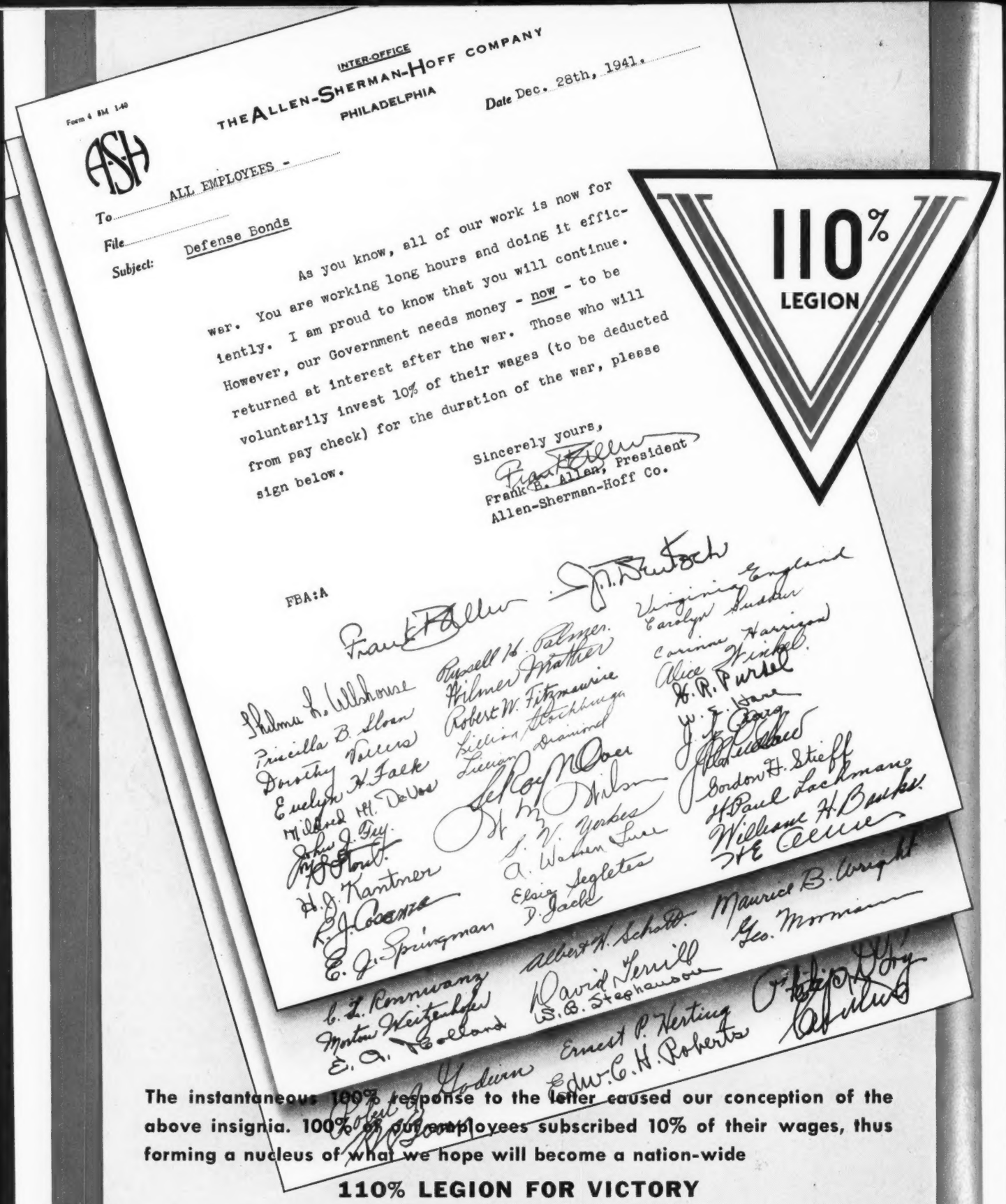


THE 73d SURVEY AND OUTLOOK NUMBER

Also the New 28x40-in. Wall Chart of
E.&M.J. Metal Prices and Production Statistics

COMPLETE CONTENTS ON PAGE 37

PRICE ONE DOLLAR



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THE ALLEN-SHERMAN-HOFF COMPANY

PHILADELPHIA

Date Dec. 28th, 1941.

To ALL EMPLOYEES -

File

Subject: Defense Bonds

As you know, all of our work is now for war. You are working long hours and doing it efficiently. I am proud to know that you will continue. However, our Government needs money - now - to be returned at interest after the war. Those who will voluntarily invest 10% of their wages (to be deducted from pay check) for the duration of the war, please sign below.

Sincerely yours,

Frank B. Allen, President

Allen-Sherman-Hoff Co.

FBA:A

110%

LEGION

The instantaneous 100% response to the letter caused our conception of the above insignia. 100% of our employees subscribed 10% of their wages, thus forming a nucleus of what we hope will become a nation-wide

110% LEGION FOR VICTORY IN AMERICAN INDUSTRY

R.G.

We have adopted this insignia to represent this accomplishment. Our employees will wear it and we proudly display it. Although this design is copyrighted, its use is offered free to any company who will certify that 100% of their employees are accepting 10% of their wages in Defense Bonds. We also have a limited number of insignia buttons that we will forward to those interested. . . . The Allen-Sherman-Hoff Company, 227 South 15th Street, Philadelphia, Penna.

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★ ★ ★ ★ ★

Credit for photographs in this issue: Front cover—Globe by courtesy of American Geographic Society. Page 57—No. 1, Press Association, Inc. photo. Pages 64-65—Guarding the Soo locks, Acme photo. Tin and rubber in Malaya, photo by Ewing Galloway. Portraits of Col. P. B. Fleming, Donald M. Nelson, and Leon Henderson, by Acme. Pouring concrete for tin smelter, photo by Wide World. Exploration trenches for tungsten in Nevada, U. S. Bureau of Mines photo. Photos of manganese test plant in South Dakota and of pilot plants at Boulder City, Nevada, by Metallurgical Division, U. S. Bureau of Mines. Page 75—No. 2, Photo from Three Lions. Other feature photographs in this issue by courtesy of the respective companies.

▼

Gold in Venezuela comes chiefly from El Callao district, which lies 120 miles by air southeast of Ciudad Bolivar on the Orinoco. Two mining companies, the Mocupia and the New Goldfields of Venezuela, respectively French and British, account for the bulk of the production. In the March issue N. B. Knox, of Caracas, will discuss the district.

▼

Metallurgists will be interested in a new electric roasting furnace suitable for laboratory testing developed at the Missouri School of Mines at Rolla, in its Metallurgical Division. Rapid desulphurization is made possible by a design providing currents of pure air that sweep over the sulphide concentrate. For a given blende, requiring 5½ hours in muffle roasting to remove 30 percent sulphur down to 1 percent or less, the objective has been obtained in less than half this time. The calcine is also said to be superior for leaching subsequently. The furnace will be described in March.

▼

U. S. Mints set new records in 1941 to provide the Nation with the coins required to do its business. They turned out more than 1,800,000,000 coins. Quite a bit of change!

H. C. PARMELEE
Editor

ENGINEERING AND MINING JOURNAL

H. W. CLARKE
Vice-President

Published by McGraw-Hill Publishing Co., Inc.

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A McGRAW-HILL PUBLICATION

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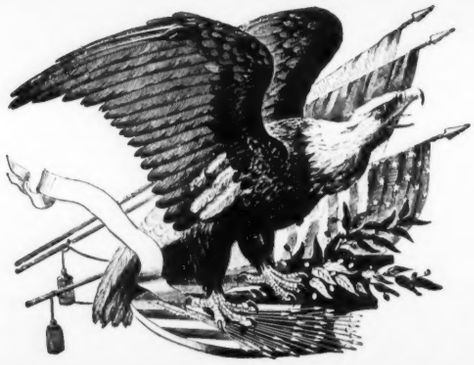
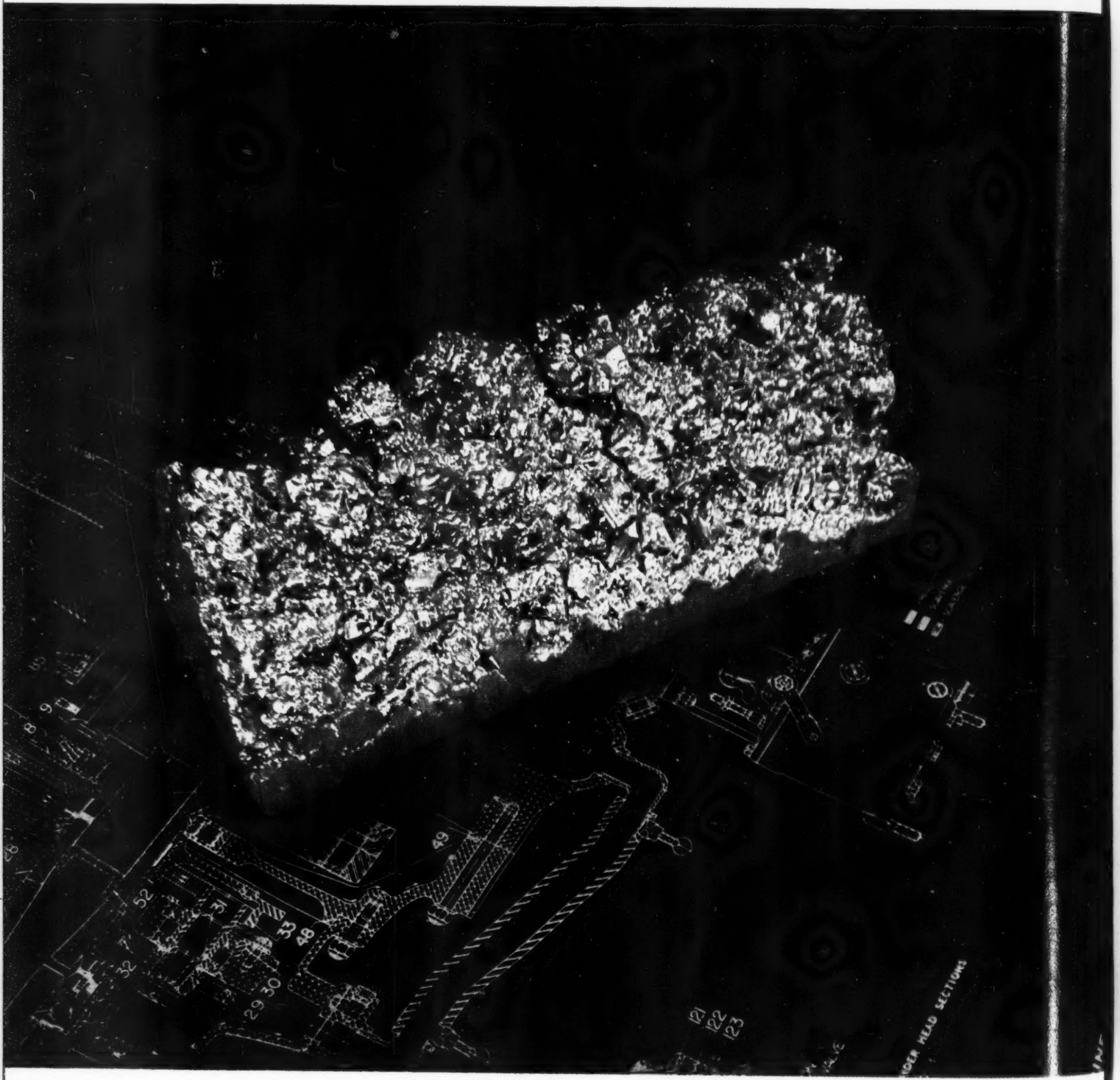
Publication Office: 99-129 N. Broadway, Albany, N. Y.
Editorial and Executive Offices: 330 W. 42d Street, New York, N. Y. Cable Address: McGraw-Hill, New York
Branch Offices: San Francisco, 68 Post St.; Chicago, 520 N. Michigan Ave.; Washington, D. C., National Press Building

McGRAW-HILL PUBLISHING COMPANY, LTD.
Aldwych House, Aldwych, London, W. C. 2, England Cable Address: Backlash, Estrand, London





American Cyanamid Company

Engineering and Mining Journal

H. C. PARMELEE, Editor

New York: A. H. HUBBELL, H. C. CHELLSON, Associate Editors; H. H. WANDERS, Market Editor; J. H. EDWARDS, Electrical Editor; W. N. P. REED, Assistant Editor. Washington, D. C.: PAUL WOOTON. San Francisco, J. B. HUTTL, Assistant Editor; G. J. YOUNG, Consultant

Volume 143 FEBRUARY 1942 Number 2

1941 REVIEW AND OUTLOOK 1942

Out of the mines the sinews of war whence the ultimate victory

PRICE CONTROL, record-breaking production, priorities, and allocations were the outstanding features of the metal mining business in 1941. None of these factors will be any less significant in 1942. In fact, controls are likely to be even more exacting for the duration of the war, particularly with respect to civilian use of metals needed for military purposes.

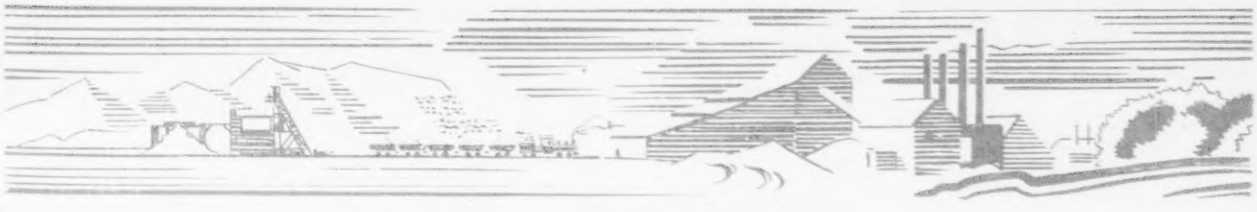
Gold and silver faded into relative insignificance as products of the mining industry, and the spotlight was held by the light-alloy metals—magnesium and aluminum; the ferro-alloy metals—chromium, manganese, molybdenum, tungsten, and vanadium; together with the old standbys—copper, lead, zinc, tin, nickel, and quicksilver. Details of price, production, and governmental controls are given in following articles.

Participation by the Government in metal and mineral production was evidenced by the activities of Metals Reserve Company and Defense Plant Corporation. The former imported copper, lead, zinc, manganese ore, chromite, tin and tin concentrates, and built stockpiles of strategics to the extent that imports could keep ahead of expanding consumption. It also bought domestic ores of manganese and chromium according to published schedules. Defense Plant Corporation financed reduction works for the production of tin, zinc, aluminum, and magnesium.

The policy of hemisphere solidarity and defense, which was so assiduously fostered by the United States during 1941, served to emphasize the importance of the mineral resources of Latin America. Direct aid in their development and production was given by personnel of the United States Bureau of Mines and the Geological Survey, and large quantities of metals and minerals were bought by the United States for defense.

Transition from national defense to war was taken in its stride by the mining industry. It had been geared to high production throughout 1941, and the formal declaration of war caused relatively little change in the plans and policies of the industry. After Pearl Harbor, shifts per day and days per week were promptly increased to the limit of the mines' capacity in an effort to meet the war production program.

A chart of *E. & M. J.* metal prices is published as a supplement to this issue of *Engineering and Mining Journal.*



COPPER

Record-breaking production fails by far to meet enormous demand. Year sees control of price and distribution, restricted use

H. H. Wanders

Market Editor
Engineering and Mining Journal

DISAPPEARANCE of refined copper in the United States during 1941 amounted to about 1,565,000 tons, surpassing all previous records by 35 percent. Exactly where this huge tonnage went cannot be stated; the information is not available. Actual consumption of copper in this country—that is, metal put into use—undoubtedly did not approach the tonnage that was absorbed by industry during the last year. The expanded defense program, enlarged during the year on several occasions; the boom conditions in business, resulting largely from the increased purchasing power of the masses; plus protective buying that was helped along by repeated warnings from Washington that civilian needs would have to be curbed, combined to create a demand for copper that could easily have absorbed 2,000,000 tons or more.

Ability of the industry to provide copper for war needs was never questioned, but all demands obviously could not be met. This inability to provide for all wants eventually brought on allocation of supplies and restriction in use of numerous copper products. Controlled distribution of copper was ordered by the Office of Emergency Management on June 1, 1941. Copper became the fourth vital defense metal to be placed under mandatory control, the other metals previously regulated being aluminum, magnesium, and nickel.

Around mid-year, when the shortages in supplies began to loom large, total military and civilian requirements in copper for 1941 were estimated at 1,810,000 tons. Supplies in sight at that time were estimated at 1,340,000 to 1,470,000 tons, with imports from Latin America an important factor in these calculations. The figures originated in Washington and pointed to a shortage of from 340,000 to 470,000 tons.

Later in the year the Office of Production Management presented the following supply-demand figures for 1942:

	TONS
Production (domestic, foreign, and scrap)	1,650,000
Demand:	
For defense, including Lend-Lease	1,050,000
For essential civilian	250,000
Other civilian	1,100,000
Indicated shortage	750,000

The cold figures released from Washington were staggering, and seasoned veterans in copper expressed bewilderment over the outlook. Producers were faced with much criticism for not producing more and more copper to satisfy the inflated demand. However, critics failed to note that producers were being asked to operate under conditions that differed radically from those to which management had been accustomed in the past. Drastic price control, the wisdom of which was not questioned, had been enforced to stem inflationary tendencies. Price control, however, in a basic raw material without due regard for all of the cost factors that make up the price was something that few could grasp. More favorable operating conditions would have brought out more copper. The copper industry, over the last ten years or so, had passed through a trying period, and the urge to "put on a little fat" was understandable.

Early in 1941 the price situation was a little muddled. Large mine operators held to the 12c. Connecticut Valley basis, concentrating on selling two and three months ahead, as usual. Custom smelters and some small producers sold copper at moderately higher levels. Leon Henderson, Price Administrator, wanted a flat price basis for copper, and publicly stated that "if the situation gets tighter, priorities are almost certain and may call for price fixing if the industry is not sensible enough to restrain itself."

The Government's adamant position in reference to copper prices was maintained throughout the year. Late in December, after some discussion of the price situation in copper at a government-management labor conference in Washington, Price Administrator Henderson clarified his stand as follows:

"The position of the Office of Price Administration is that 12c. a pound is an adequate price for by far the bulk of the copper being produced in the United States. . . . Only a small part of the country's current and potential output requires prices above 12c. OPA will approve prices above 12c. for additional copper that cannot be produced profitably at this price. Approval has already been given in a number of instances. This system of differential pricing permits maximum production without the serious inflation which would attend a rise of several cents in the price of all copper."

A formal ceiling of 12c. a pound was imposed on the industry early in August and allocation of copper by the Priorities Division of the Office of Production Management was announced at the same time. In announcing the ceiling price, Mr. Henderson pointed out that Metals Reserve Co. would be asked

WORLD'S COPPER PRODUCTION — In Short Tons

Country	1938	1939	1940	1941
United States	556,673	734,990	892,270	979,500
Canada	290,200	310,257	(*a*) 350,000	(*b*)
Mexico	45,662	53,790	45,000	50,000
Chile	387,409	373,870	388,500	502,000
Peru	41,368	39,260	40,700	40,000
Germany	33,069	(*a*) 33,000	(*a*) 35,000	(*b*)
Russia	(*a*) 108,000	(*a*) 118,000	(*a*) 120,000	(*b*)
Spain and Portugal	37,964	28,439	(*a*) 35,000	(*b*)
Japan	(*a*) 84,900	(*a*) 84,900	(*a*) 84,000	(*b*)
Africa	295,337	393,442	(*a*) 410,000	(*b*)
Elsewhere	203,455	215,417	225,000	(*b*)
Totals	2,184,037	2,385,365	(*a*) 2,625,470	(*a*) 2,790,000

Statistics based on blister copper, so far as possible, and referred to countries wherein ore originated. Does not include secondary copper. Figures for 1938 and 1939 by American Bureau of Metal Statistics: 1940 and 1941 *E. & M. J.* estimates. (*a*) Conjectural. (*b*) Not available.

to buy high-cost copper at above 12c. a pound to keep production at the highest possible level. He suggested that the Government agency pay 1c. a pound above the "out-of-pocket" cost to those companies whose costs were in excess of 11c. a pound in the first six months of 1941. "Out-of-pocket" cost was defined as cost exclusive of depreciation, depletion, and amortization of deferred charges. Another condition for obtaining a higher price for copper was that cost would be determined by independent audit.

During 1941, contracts to purchase copper above 12c. were closed with three small Michigan producers—Copper Range, Isle Royale Copper, and Quincy Mining. That more producers did not exercise the privilege of signing up with Metals Reserve was probably due to the terms, which, to put it mildly, did not fit all cases.

Copper purchased by Metals Reserve, unless disposed of otherwise, went into the common pool and was sold to consumers at the ceiling price of 12c. During the year, Metals Reserve purchased Latin American copper in volume to supplement domestic supplies. As of Oct. 22, 1941, it had contracted for 550,500 tons of foreign copper, of which 333,380 tons had been delivered. Initial purchases of foreign copper were made on the basis of 10c. a pound, United States ports. Later in the year, however, the price paid was raised to 11¼c., and, as 1941 ended, negotiations were on for additional supplies for which the Government was prepared to pay close to the 12c. equivalent to allow for higher costs and taxes at producing centers.

Authorities in Chile and other Latin American copper producing countries soon learned that metal imported into the United States was distributed to consumers "at the market," or on the 12c. basis. And it was generally recognized that copper imported by the Government under war conditions fell into a different category than metal imported privately. In other words, the 4c. import tax became inoperative under those conditions.

Production of refined copper (duty-free copper) during 1941 was 1,065,667 tons, according to Copper Institute, a new high, comparing with 1,033,710 tons in 1940 and 818,289 tons in 1939. Total deliveries for 1941 amounted to 1,513,423 tons, which contrasts with 1,050,423 tons in 1940 and 948,559 tons in 1939. Out of the record tonnage delivered to consumers during 1941, the Metals Reserve Co. contributed 380,417 tons.

Smelter production of copper from domestic ore during 1941 totaled 979,500 tons, according to a preliminary estimate by the Bureau of Mines. This output compares with 909,083 tons in 1940 and 712,674 tons in 1939. Production last year fell short of the record for mine output established in 1929 by about 20,000 tons. Operating conditions, it should be recalled, were not the same last year as in 1929. For one thing, the 4c. import duty, which was made "permanent" during 1941, was not yet heard of.

Scrap copper did not flow to the refineries in anything near the volume expected. Primary plants treated approximately 90,000 tons of it in 1941, against 117,650 tons in 1940. Competition for it was keen, and refineries could not bid for such material on an equal basis with other buyers, because of price-control in copper. To correct this condition, allocation of scrap was being considered toward the end of the year.

Rigid control over copper consumption through curbing manufacturing operations in a long list of products

(*Continued on page* 52)

U. S. COPPER STATISTICS (COPPER INSTITUTE)—In Short Tons

1941	Production (a) Crude	Production Refined	Deliveries (b) Refined	Stocks (c) Refined
January	83,280	93,840	119,758	116,854
February	79,240	93,654	112,819	97,689
March	85,701	95,322	134,339	89,873
April	88,042	89,687	123,629	98,789
May	90,342	89,390	144,293	93,076
June	82,558	88,560	115,139	98,164
July	82,099	86,879	143,122	74,384
August	84,695	85,426	117,486	71,930
September	81,839	81,553	121,021	63,670
October	86,019	86,617	121,457	67,260
November	84,718	84,799	123,168	72,352
December	86,961	89,940	137,368	75,564
Totals	1,015,494	1,065,667	1,513,599	.....

(*a*) Smelter production, including scrap. (*b*) Beginning March, includes foreign copper released by MRC. (*c*) At refineries, etc.; does not include stocks at consumers' warehouses.

ZINC

Smelter capacity and metal output up. The year brings allocation

Marshall L. Havey

Vice President
The New Jersey Zinc Co.

A LOOK at the year's happenings in the zinc field has been summarized in the briefest manner by one publication, which said recently, in commenting upon the past few months: "The zinc situation has been so well worked out and so well geared into the defense program that matters run along from day to day, week to week, and month to month without much that makes news, except occasionally."

The plan set up by the OPM in collaboration with the zinc industry to replace the "voluntary rationing" for zinc, was instituted last April with the taking by the Priorities Division of 5 percent of the January production of slab zinc to be allocated by the Division. In June this plan was formalized by the General Preference Order M-11 covering zinc. This order was issued to expire Dec. 31, but has been extended to March 31, 1942. There has been no notable change in the principle of operation since the plan became effective in April. The fine spirit of cooperation which has characterized all of the numerous meetings of OPM and zinc industry representatives should be recorded, and it would seem reasonable to conclude that the extension of the zinc order was an indication of the success of their mutual efforts, and, of course, the basic soundness of the plan itself. Tabulation of percentages taken monthly by OPM, and an estimate of the tonnage, are given in Table I, page 44.

There has been only one change (Oct. 10, 1941) in the slab zinc price since Sept. 24, 1940. This raised the price of Prime Western zinc 1c. per pound to 8¾c.

As soon as the Nazi forces swept through the Low Countries and France fell in the summer of 1940, the whole zinc supply situation assumed a new aspect. Great Britain turned to the United States as a source to replace French and Belgian zinc no longer available. And our own country, realizing the potential war threat which has since become a reality, called for

WORLD'S ZINC PRODUCTION — In Short Tons

Country	1938	1939	1940	1941
United States	456,990	538,198	706,100	864,026
Canada	171,656	178,301	187,000	(b)
Mexico	41,338	50,989	38,000	40,000
Belgium	231,924	204,697	(b)	(b)
France	68,532	66,427	(b)	(b)
Germany	212,173	234,000	(b)	(b)
Great Britain	61,938	55,600	(b)	(b)
Poland	122,119	130,000	(b)	(b)
Australia	78,198	78,000	(b)	(b)
Russia	(a) 88,184	(a) 99,200	(a) 105,000	(b)
Elsewhere	219,278	214,300	(b)	(b)
Totals	1,752,330	1,849,712	.....	.....

Production by primary metallurgical works. Figures for 1938 and 1939 by American Bureau of Metal Statistics; 1940 and 1941 *E. & M. J.* estimates. (a) Conjectural. (b) Not available.

greatly increased amounts of zinc for the Defense Program. At the same time accelerated business conditions increased consumption of zinc in non-defense goods.

The zinc industry of the United States, looking to the immediate emergency, took steps in two directions to meet the new conditions. Smelters which had been unable to operate successfully in a world at peace without a sufficient protective tariff were renovated, and entirely new capacity was constructed. And so 1941, in retrospect, shows one smelting unit after another being brought in, together with an expanding ore supply from increased domestic and foreign output for the smelters to work. As a consequence, 1941 production of slab zinc in the United States was approximately 864,000 tons, and 1942 production will be even larger.

The monthly statistics of the American Zinc Institute were revised last September. These figures now include production of slab zinc from foreign ores, and indicate the progress of zinc production more clearly and in a more useful manner than previously available figures which included domestic production only. They provide a lucid statistical picture for viewing the zinc industry in its relation to the whole war program.

Actually, the uses of zinc today are no different from those in normal times, but the increased demand on each of the many uses having a part in our military program pyramids the load for the zinc industry. Thus it is that manufacturers of consumer products have not been able to obtain all of the zinc they would like to use. This is part of the price that must be paid for military victory.

The most important thing to say at this moment, when all the world is at war, is that there is sound basis for believing that the military requirements for zinc (including Lease-Lend) even under the recently expanded war program, are within the existing smelting capacity of this country now in operation on an increased supply of domestic ore and on foreign ore available by rail or short haul by boat. Projected increases in smelting capacity will afford an added assurance of a sufficient supply of zinc. This statement is based not only on the increased production of zinc, but also on the important fact that zinc is not used by itself alone, except for the small proportion of production which goes into rolled zinc. The requirements of zinc, consequently, depend upon the available supply of copper and steel and, in the case of zinc alloys, upon the amount of aluminum and magnesium available for use in these alloys.

It would appear reasonably certain, therefore, with the slab zinc production in Mexico added to the present and projected production in the United States, that, so far as the war program is concerned, there will be sufficient zinc to take care of all military requirements.

Table I—Zinc Tonnage Taken by OPM

1941	OPM Percent	Basis Month	Pool Tons (Est.)
April	5	January	3,000
May	17	March	12,500
June	22	April	15,000
July	22	May	16,000
August	27	June	19,000
September	27	July	20,000
October	27	August	20,500
November	31	August	24,000
December	29	August	22,000
Total			152,000

Note: For January, 1942, OPM set aside 31 percent of October, 1941, production.

Table II—U. S. Zinc Production, 1929 to 1941 Smelter Basis, in Tons

(American Zinc Institute)

	Production	Daily Rate
1929	631,601	1,730
1930	504,463	1,355
1931	300,738	822
1932	213,531	583
1933	324,705	890
1934	366,933	1,004
1935	431,499	1,108
1936	523,166	1,429
1937	589,619	1,615
1938	456,990	1,252
1939	538,198	1,475
1940(a)	706,100	1,929
1941(a)	864,026	2,367

(a) Figures for 1940 and 1941 include production of slab zinc from both domestic and foreign ore. Totals for prior years do not include production from foreign ores, which was not a vital factor in those years.

In a paper on the zinc outlook, presented by Howard I. Young, president of the American Zinc, Lead & Smelting Co., before the New York Section of American Institute of Mining and Metallurgical Engineers late last year, the following statistics on the needs of consumers and other requirements appeared:

	1941	(a) 1942
Galvanizing	312,000	312,000
Brass mills	240,000	360,000
Die casting	120,000	100,000
Rolling mills	84,000	67,000
Oxide plants	18,000	18,000
Other uses	12,000	12,000
	786,000	869,000
Estimated exports	150,000	150,000
Total needs	936,000	1,019,000

(a) Estimated consumption based on adjustments to balance production and consumption.

Curtailment in use of zinc in 1942 will occur in passenger automobiles, refrigerators, washing machines, galvanizing, and other items, which, it was pointed out, should result in lessened consumption of zinc in other than defense materials.

Production of slab zinc in the United States for the year 1941 will come close to 878,000 tons, to which should be added some 36,000 tons imported from Mexico and available for consumption or for export, giving a total supply of 914,000 tons.

Mr. Young told those present at the meeting that the production of slab zinc by domestic smelters in 1942, including the expected production from new units, will total about 953,000 tons. Adding to this the tonnage imported from Mexico available for domestic consumption or for export, this country will have a total supply of 989,000 tons for 1942.

Estimated rate of current production of zinc in the British Empire, Russia, and such production in Mexico and elsewhere that is not included under available domestic supply in the two preceding paragraphs, is 500,000 tons annually, making the total supply of zinc available outside of Axis control in 1942 about 1,489,000 tons. Of this tonnage, approximately 1,189,000 tons will be produced on the North American continent, Mr. Young declared.

LEAD

Foreign metal aids in meeting record demand. Price rise delayed

F. E. Wormser
Secretary
Lead Industries Association

IN 1941 LEAD WAS CALLED on not only to serve as an essential war metal in direct military applications such as ammunition, storage batteries, bearing metals, and dozens of additional defense uses, but was also required, as an alternate, to help relieve the shortage in the supply of other non-ferrous metals, notably aluminum, copper, zinc, and tin. Early in the year it was believed that supplies of lead would be ample for both defense and greatly enlarged civilian use, but it soon became apparent there was a limit to the burden which lead could carry for other metals. By October lead was placed under government control by the Office of Production Management, under Order M-38, to insure preference for defense business. Indeed, had it not been for the large supplies of lead pouring into the United States from contiguous Mexico and Canada, with additional supplies from Australia, Peru, and other countries, to help fill the growing and unprecedented domestic demand, it is quite likely that lead would have followed in the footsteps of copper and zinc toward government control much sooner than it did.

All records have been broken in the consumption of lead by the United States. Preliminary estimates indicate that over 900,000 tons of primary lead (of domestic and foreign origin) was shipped to domestic consumers during 1941, of which 450,000 tons was derived from domestic mines. Last May the rate of consumption began to be even greater, averaging about 80,000 tons per month for the rest of the year. It would have been still higher if the lead had been available. The best previous year was 1926, with 718,000 tons shipped to consumers.

At the end of 1941 the statistical lead picture was approximately this:

Production from:	Tons per Month
Domestic mines	43,000
Secondary (*a*) and foreign ores	8,000
Imports from:	
Mexico	15,000
Canada	4,000
Australia (*b*)	6,000
Peru (*b*)	3,000
Total supply	79,000
Total shipments	80,000 to 85,000

(*a*) Secondary lead by primary smelters.
(*b*) Dependent on shipping.

The disparity between production and shipments has been bridged mainly by drawing on stocks accumulated by the Metals Reserve Company last July of 63,850 tons from foreign producers, as well as drawing upon domestic refined stocks, which closed the year at 10,000 tons, compared with 40,000 tons on Jan. 1, 1941.

All defense requirements have been easily met and a comparatively moderate increase in domestic production, together with a slightly enlarged supply from Mexico and Canada, might well bring about a comfortable lead position in that practically all the most needed civilian requirements could be satisfied.

(*Continued on page* 52)

WORLD'S LEAD PRODUCTION — In Short Tons

Country	1938	1939	1940	1941
United States	379,636	420,427	454,340	496,500
Canada	204,646	196,059	(*b*)	(*b*)
Mexico	267,530	237,742	216,270	187,000
Germany	189,265	200,000	(*a*) 210,000	(*b*)
Belgium	99,758	105,821	(*b*)	(*b*)
Italy	47,741	42,000	(*a*) 42,000	(*b*)
Spain	39,683	29,800	(*a*) 35,000	(*b*)
Russia	(*a*) 76,059	(*a*) 82,700	(*a*) 85,000	(*b*)
Australia	259,771	278,200	(*a*) 280,000	(*b*)
Burma	89,713	86,666	(*a*) 84,000	(*b*)
Elsewhere	224,727	219,553	(*b*)	(*b*)
Totals	1,878,529	1,898,968	.....	.....

In terms of base bullion, allocated so far as possible according to country of origin of ore. Figures for 1938 and 1939 by American Bureau of Metal Statistics; 1940 and 1941 *E. & M. J.* estimates.
(*a*) Conjectural. (*b*) Not available.

TIN

Tense year ends with strict control. Metal reserves increased

H. H. Wanders
Market Editor
Engineering and Mining Journal

UNDER ORDINARY CONDITIONS the big news in tin for 1941 would have been the renewal of the international restriction scheme for a period of five years, after appropriate changes in quotas were finally agreed on. But the gods decreed otherwise. War in the Far East, that crashed upon the World on Dec. 7, stopped the clock so far as tin was concerned. The Government took charge of all supplies of the metal in the United States and afloat, and, effective Dec. 17, specific allocation of tin was taken over by the Director of Priorities of OPM.

A state of tension had existed in the tin market throughout the year. Both the Government and consumers of tin purchased substantial tonnages to build up reserves. As a result, the year ended with slightly more than a year's supply of virgin tin on hand, at normal demand levels. Careful conservation of supplies was ordered, and it was hoped that stocks could be stretched through any possible emergency period.

General Preference Order M-43, issued late in the year by Donald M. Nelson, then Director of Priorities of OPM, contained the following provisions:

1—All supplies of tin shall be subject to specific allocation by the Director of Priorities, and the purposes for which tin is used shall also be specified.

2—No tin may be sold or delivered without specific permission of the Director of Priorities.

3—Future imports of tin may not be sold except to the Metals Reserve Co., or other governmental agency.

4—Tin afloat may not be sold except by special permission.

A ceiling on tin prices became effective on Aug. 16, establishing Straits tin at 52c. a pound, or 2c. a pound higher than the figure at which Metals Reserve Co. had agreed to accumulate substantial tonnages. Several price

(*Continued on page* 53)

THE LIGHT METALS

Production of aluminum doubled and of magnesium quintupled in 1941 in race with the Axis. Additional plants being built

Herbert A. Franke
Metal Economics Division
Bureau of Mines, Washington, D. C.

WITH ever-increasing demands for airplanes, warships, and other weapons of modern warfare, more and more attention has been focused upon aluminum and magnesium, which are essential to their production. From 1939 to 1940, output of aluminum was increased from 327,090,000 to 412,560,000 lb., and of magnesium from 6,700,122 to 12,521,726 lb. In 1941, over 600,000,000 lb. of aluminum and more than 30,000,000 lb. of magnesium were produced, and much larger quantities are scheduled for 1942 and 1943. In June 1941, the Office of Production Management stated that expanded national defense and Lend-Lease programs would require an annual domestic productive capacity of 1,400,000,000 lb. of aluminum (plus an additional 200,000,000 lb. to be imported) and 400,000,000 lb. of magnesium. Now under the new Victory program there are possibilities that even these requirements may be raised so that armament production may be increased further.

ALUMINUM—Under the defense program it was estimated that aluminum, abrasive, chemical and other consumers would annually need the equivalent of at least 2,882,000 long tons of high-grade Arkansas bauxite or 2,378,000 tons of South American ore. It is planned to more than double the present annual domestic bauxite output of about 1,000,000 tons and, in addition, to import approximately 1,300,000 tons of ore. In 1941 the United States produced more bauxite than ever before—about 900,000 tons—more than twice that of 1940 and about 50 percent more than the output in the previous peak year of 1918. There were ten producers of bauxite in 1941, and as usual Arkansas supplied over 90 percent of the country's output. Large-scale stripping operations were conducted during the year in anticipation of great demand for this important mineral, when the new alumina plant now being built is completed. Imports also set a new record in 1941 and at the end of September totaled 749,264 tons, 75 percent more bauxite than was received during the same 1940 period. Surinam supplied 85 percent of this ore. Exports during the first nine months of 1941 aggregated 98,023 tons (72 percent above those in 1940), and were destined chiefly to American-owned abrasive plants in Canada.

In addition to the new Government alumina plant mentioned, more bauxite must be mined and imported in 1942 to supply expansion in existing alumina plants belonging to the Aluminum Company of America and Reynolds Metals Co. In Utah a small alumina plant is being built to use alunite, and also possibly clay, as the raw material.

By the end of 1942, the alumina-producing capacity of the United States should have been greatly increased. Bauxite to supply the alumina plants and other consumers can be drawn only from very large South American or limited domestic ore reserves. Estimates by the Bureau of Mines and Geological Survey place domestic bauxite reserves of metallurgical or Grade "A" ore (55 percent or more Al_2O_3, 7 percent or less SiO_2) at only 9,343,000 long tons (mined and dried basis). Because of this limited quantity of high-grade ore, present plans for expanding production include the use of substantial quantities of Grade "B" and possibly some Grade "C" ore, of which we have estimated reserves of 8,898,000 and 8,439,000 tons, respectively.

Aluminum production in 1941 exceeded 600,000,000 lb.—almost 50 percent above the previous peak output of 1940. Early in 1942, the Aluminum Company of America and the Reynolds Metals Co. are expected to be producing metal at an annual rate substantially exceeding 800,000,000 lb. During the first nine months of 1941, the United States imported 19,536,527 lb. of crude and semi-crude aluminum, virtually all from Canada, which was 24 percent less than that received for the same period of 1940. Exports

ESTIMATED WORLD BAUXITE, ALUMINUM AND MAGNESIUM PRODUCTION — (In Metric Tons)

Country	Bauxite		Primary Aluminum		Magnesium	
	1939	1941	1939	1941	1939	1941
Canada	.....	.....	75,000	(*b*)	.....	.....
France	700,000	*700,000	50,000	*65,000	2,500	*8,000
Germany (*a*)	*20,000	*25,000	*200,000	*300,000	*16,500	*35,000
Greece	186,906	*50,000	.....	.....	.....	.....
Guiana, Brit	483,653	1,000,000	.....	.....	.....	.....
Guiana, Dutch	511,619	1,000,000	.....	.....	.....	.....
Hungary	*485,000	*1,200,000	*1,500	*5,000	.....	.....
Italy	*483,965	*600,000	*34,200	*50,000	*300	*5,000
Japan	.....	.....	*23,000	*90,000	*2,000	*3,000
D. E. Indies	(c) 230,668	(c) 400,000	.....	.....	.....	.....
Norway	.....	.....	31,000	*40,000	.....	*500
Switzerland	.....	.....	*28,000	*30,000	*700	*1,000
U. S. S. R.	270,000	250,000	45,000	60,000	1,000	5,000
United Kingdom	.....	.....	25,000	(*b*)	4,831	(*b*)
United States	381,331	920,000	148,400	280,000	3,039	15,000
Yugoslavia	318,840	*300,000	2,400	*3,000	.....	.....
Others	132,910	145,000	3,500	(*b*)	.....	(*b*)
*Total Axis	*999,755	*2,933,800	*287,500	*587,000	*19,500	52,566
Total Allies	3,205,137	3,656,200	379,500	590,000	11,370	35,200
Grand total	4,204,892	6,590,000	667,000	1,177,000	30,870	87,700

(*a*) Including Austria.
(*b*) Estimate included in total.
(*c*) Most of bauxite shipped to Japan and Germany though under control of Allies.

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totaled only 10,244,979 lb., which was 80 percent less than during the 1940 period.

The Aluminum Company of America reduced the price on primary aluminum 2c. a pound on Oct. 1, 1941, which (with the 3c. drop in 1940) brought the quotation down from 20 to 15c. within two years. In the fall of 1941 a decision on the monopoly charges by the Department of Justice against the Aluminum Company of America was handed down in a New York Federal Court in favor of the company. The aluminum industry was hampered by only minor labor difficulties during the year. The Reynolds Metals Co., new competitor of the Aluminum Company of America, started operations at both its new plants and entered into a 12-year contract with the N. V. Billiton Maatschappij to supply it with a large tonnage of Surinam bauxite.

Aluminum was the first metal upon which formal mandatory industry-wide priorities were invoked—on Feb. 24, 1941. When it became obvious that even the $200,000,000 expansion program of the Aluminum Company of America and the $20,000,000 program of the Reynolds Metals Co. would not meet military requirements, the Office of Production Management recommended that the Government finance facilities to produce an additional large tonnage of the metal. The Government later completed contracts with the Aluminum Company of America for the construction of 512,000,000 lb. of aluminum and 1,000,000,000 lb. of alumina capacity, and with the Olin Corporation for 30,000,000 lb. of aluminum and 20,000,0000 lb. of alumina capacity. It loaned the Reynolds Metals more money, so that its annual production capacity could be expanded from 100,000,000 to 160,000,000 lb. of aluminum and to 200,000,000 lb. of alumina. Contracts also were completed or authorized with the Reynolds Metals Co., Extruded Metals Defense Corporation, Bohn Aluminum & Brass Corporation, and Aluminum Company of America for the fabrication of more aluminum alloy sheet and extruded products. Power to produce the additional quantities of aluminum will come from Government hydroelectric and steam plants in various localities. During the year, aluminum scrap was brought under full priority control, ceiling prices were established on aluminum scrap and secondary ingot, and a nationwide scrap-collection campaign was inaugurated which yielded approximately 11,250,000 lb. of scrap containing about 6,750,000 lb. of recoverable aluminum.

MAGNESIUM—Domestic magnesium output in 1941 exceeded 30,000,000 lb. The Dow Chemical Co. made virtually all of this production, hav-

(*Continued on page* 49)

FERRO-ALLOY METALS

Full priority control for chrome and vanadium. Check on tungsten purchases. New peak for molybdenum. Manganese output up

Metal Economics Div.
Bureau of Mines, Washington, D. C.

REVIEWS of the situation that has obtained during the past year in respect to chrome ore, manganese, molybdenum, tungsten, and vanadium have been prepared by three of the staff members of the Metal Economics Division of the U. S. Bureau of Mines. The author's name in each case is given at the end of the summary prepared by him.

CHROMITE — The demand for chromite continued to increase during 1941. Despite shipping difficulties and the limitation, or even complete curtailment of imports from some sources, the influx of foreign ore was greater than in 1940. A sharp rise was shown in nominal prices quoted for foreign ores. Domestic production received impetus from the greater demand and the likelihood that foreign supplies might become unavailable with the spread of the war.

Imports for the first nine months of 1941 were 660,936 long tons, compared with 657,689 long tons for the entire year 1940. The increased rate of foreign-ore entry in 1941 was due mainly to shipments from Cuba, Africa, and the Philippine Islands. Supplies from Turkey and New Caledonia were slow in coming in at the beginning of the year but later entered more rapidly.

Domestic production of chromite in 1941 totaled over 12,000 long tons, against less than 3,000 in 1940. About 25 operations in California and Oregon reported actual production at some time during the year. As in 1940, the Pilliken mine, in California, was the largest producer.

The Government was active in purchasing chromite for stockpiling. It was reported in July that all the Transvaal and Indian ores were sold out beyond the end of 1941 and that the principal purchaser was the Metals Reserve Co. A letter issued by this agency on Nov. 14 gave the specifications regarding contracts for purchase of domestic ore. The company considered two grades in its contracts: 45 percent Cr_2O_3 (Cr:Fe=2.5:1) and 40 percent Cr_2O_3. On Dec. 19 a new schedule established two types of the 40 percent grade, made changes in prices and delivery procedure, and reduced minimum quantity of purchases from 5,000 to 1,000 long tons. Price adjustments on the stated basic rates are specified for deviations from the established grades.

In July the Office of Production Management placed chromium under full priority control. Late in November the order was redefined, intensifying the control over deliveries. Special restriction was placed on consumption of chromium in the manufacture of chemical products. At the same time, an order was issued prohibiting the manufacture and delivery of chrome steel except under a preference rating of A-10 or higher.

The Office of Production Management announced in December that all American ferrochromium manufacturers had voluntarily agreed to change specifications, as follows: 68 to 69 percent Cr, 4 to 6 percent C, 1 to 2 percent Si to 60 to 63 percent Cr, 6 to 8 percent C, 4 to 6 percent Si. The new specifications, representing a return to those of 20 years ago, will allow the use of lower-grade ores. The change will affect only the type of ferrochromium used in making engineering steels with a maximum chromium content of about 3 percent.

Exploratory work on chromite deposits by the Bureau of Mines and the Geological Survey was carried forward in 1941. Deposits in California, Oregon, Washington, and Montana have been examined.

Upon recommendation of the Office of Production Management, the Government negotiated with the Anaconda Copper Mining Co. for the development of the Stillwater deposits, in Montana. The Defense Plant Corporation awarded $1,740,000 to the company for construction and equipment of the mining and milling operations. The properties were leased through the Metals Reserve Co., and the operations will be pursued on a nonprofit basis. Anaconda expects to produce 650 tons of ore per day. The Stillwater deposits have long been known to contain a large tonnage of ore, the low-grade and low chrome-iron ratio of

which prevented exploitation before the emergency.

United States Vanadium Corporation has acquired deposits that it intends to work in Montana and has built a 100-ton mill to be placed in operation during 1942. A 200-ton mill is being erected by the Rustless Mining Corporation operating in California.

Frederick Betz, Jr.

MOLYBDENUM — Domestic production of molybdenum in 1941 probably will approximate 40,000,000 lb., an all-time high, exceeding the peak established in 1940 by about 6,000,000 lb. The principal producer, Climax Molybdenum Co., was reported to be operating near capacity to meet defense orders. The Climax company is improving its plant facilities to increase its output. Increases were also reported by other large producers. Production appears to have been slightly in excess of shipments.

Exports of ore and concentrates in 1940 dropped about 71 percent to a total of 6,684,714 lb. contained molybdenum. During the first nine months of 1941, exports amounted to 4,778,419 lb. of molybdenum, indicating that these shipments were being continued at about the 1940 level. No imports of molybdenum were recorded in 1940 or during the first nine months of 1941.

Demand for molybdenum in defense and normal uses has grown with great rapidity. In an effort to conserve tungsten the Government prescribed regulations forcing the substitution of molybdenum steels for high-speed tungsten steels.

The nominal price quoted for molybdenum ore remained throughout 1941 at 45c. per pound contained MoS_2 for 90 percent concentrates.

As to the future the outlook depends largely on the ability of present producers to meet the rising demand. New domestic sources of molybdenum are not known, and all exploratory work is said to have yielded negative results.

Frederick Betz, Jr.

VANADIUM — Domestic production of vanadium in 1941 is believed to have risen above the 1940 figure of 2,000,000 lb. At the same time, the demand has been approximately doubled in the last year, and a further large increase in domestic needs is expected in 1942. Imports during the past several years have come exclusively from Peru. In 1940, 2,574,591 lb. of vanadium were obtained from that country, and during the first nine months of 1941 imports totaled 1,720,793 lb. These figures indicate a lower monthly rate of entry in 1941. Thus, the total available supply will all be required.

Use of vanadium as a substitute for other alloying elements in steel is in part responsible for the present existing situation. To fulfill defense requirements, vanadium was placed under full priority control in August by the Office of Production Management.

The major part of the domestic vanadium ore production is derived from western Colorado and southeastern Utah. Expansion of present facilities by the large producers of concentrates is taking place in two places in Colorado. The Defense Plant Corporation announced late in 1941 that a lease agreement had been made with the Vanadium Corporation of America for the construction and equipment of a plant in the State of Utah, to be used in the production of vanadium oxide. It is reported that the mill will have a 100-ton daily capacity.

Special attention is being given to other sources of vanadium. A newly developed source in 1941 was phosphates, from which vanadium was recovered by the Anaconda Copper Mining Co. It has been found that Venezuela fuel oil contains a significant quantity of vanadium and also that vanadium-bearing iron ores are a possible source of this element. In a report from the U.S.S.R. it was claimed that a naturally alloyed vanadium pig iron had been produced from titaniferous magnetites for the first time anywhere. Titaniferous magnetites characteristically contain vanadium in small amounts, but hitherto certain inherent characteristics of these ores have prevented their exploitation for any purpose.

A purely nominal price is quoted for vanadium ore. Since 1935, the price has remained 27½c. per pound of contained V_2O_5.

Frederick Betz, Jr.

TUNGSTEN—Consumption of tungsten concentrates in the United States reached an all-time high in 1941, and as a consequence both imports and domestic production established new records. Imports (receipts) during the first nine months of 1941 were 11,349 short tons (60 percent WO_3 basis); China and Bolivia were the chief sources. Imports were 10,157 tons during the entire year 1940. Domestic production will approximate 6,500 short tons (60 percent WO_3) in 1941, compared with 5,120 tons in 1940. California and Nevada were the principal producing States. The high-grade tungsten deposit in the Yellow Pine district, Valley County, Idaho, which was discovered jointly by engineers of the Bureau of Mines and geologists of the Geological Survey, made its initial production and shipment in August 1941. The ore is said to average about 2 percent WO_3. Many new mills were completed in 1941, noteworthy of which was the 1,300-ton-daily-capacity concentrating and chemical plant in California which began operating in October. Additions to capacity were made at some existing mills.

The Government program to buy tungsten for stockpiling and for resale to industry made considerable progress in 1941. Release to industry of part of the Government-held stockpile relieved a temporary stringency in the spot supply in the early part of 1941, which developed as a result of the closing of the Burma Road in the fall of 1940.

To conserve the nation's supply of tungsten and divert part of the demand for high-speed tungsten tool steel into molybdenum-type steel, the Director of Priorities on June 11, 1941, issued General Preference Order M-14, which provides that, during any three-month period, a customer for high-speed steel may purchase the tungsten steel only to the extent that he buys an equal amount of molybdenum steel which contains less tungsten. An amendment to this order, issued on Nov. 29, provides that 75 percent of all high-speed steel orders accepted in any one quarter shall be of the molybdenum type and not more than 25 percent tungsten type.

Chinese ore was quoted at $26 per short ton unit of WO_3, duty paid, at the beginning of 1941 but shortly thereafter was lowered to $24 to $24.50. On the other hand, domestic scheelite, which was quoted at $23 to $24 per short-ton unit delivered at buyers' plants during the first nine months, was advanced to $24 to $27 in early October and to $26 to $27 in late October.

The Metals Reserve Co. announced on May 21 that it had entered into a contract with Bolivian producers, guaranteed by the Bolivian Government, to purchase Bolivia's entire tungsten production for three years at $21 per short-ton unit. Metals Reserve and the Defense Supplies Corporation entered into an agreement to buy, at market price at the time of purchase, any surplus Mexican tungsten not sold to private industry in the Western Hemisphere.

H. W. Davis

MANGANESE—Production of domestic manganese ore containing 35 percent or more manganese showed a general upward trend during 1941. First it declined from 2,100 gross tons in January to 1,800 in March, then rose to a high of 9,400 tons in September as the new treatment plant of the Anaconda Copper Mining Co. approached full-scale operation. Production during the first ten months of 1941 totaled 91,000 tons compared with 36,429 tons during entire year 1940.

Government purchases of manganese ore are made by the Metals Reserve Co., Washington D. C. Deliveries to that agency for Government stockpile purposes increased greatly during the year. Contracts for foreign ore totaled 1,464,700 tons by Nov. 28, with Cuba

heading the list in amount contracted for. India, South Africa, and Philippine Islands followed in that order. Of the 351,317 tons delivered, South Africa was the chief supplier, followed by India, the Philippines, and Cuba. Contracts for domestic manganese ore totaled 1,925,000 tons on Nov. 28, with deliveries (all in 1941) amounting to only 18,862 tons. On Nov. 14, 1941, an order was issued from the Metals Reserve Co. to purchase manganese ore containing as low as 40 percent manganese. On Dec. 19, a new schedule lowered the minimum contract from 5,000 to 1,000 tons and liberalized regulations regarding delivery of ore.

Prices of manganese ore rose steadily during the first six months of the year and dropped slightly during the closing months. According to *E.&M.J. Metal and Mineral Markets,* late in November the price of Brazilian ore (46 to 48 percent) was $0.63 per long-ton unit: Chilean ore (47 to 48 percent) was $0.65, and South African (50 to 52 percent) $0.68.

Imports continued at a high rate during the first nine months of 1941 and totaled 853,189 tons containing 401,611 tons of manganese. Import data after Sept. 30, 1941, are of a confidential nature and may not be published. Imports during 1940 totaled 1,294,316 tons containing 615,943 tons of metallic manganese.

Shipments of manganese ore from Butte by the Anaconda Copper Mining Co. in fulfillment of its contract with the Metals Reserve Co. began in June. Anaconda's new plant treats low-grade rhodochrosite ores by a process of selective flotation, which not only recovers a high-grade manganese concentrate but also the lead, zinc, and silver content. The manganese nodules produced have a manganese content considerably above the minimum requirements for ferro-grade ore.

The first unit of a group of pilot plants built by the Bureau of Mines at Boulder City, Nev., under a defense appropriation began operations in September 1941. A test run has demonstrated the feasibility of one of the processes developed in the Bureau laboratories for recovering commercial-grade products from low-grade domestic ores. The product produced in the first operations analyzed, after sintering: 52 percent manganese, 1 percent iron, and 9 percent silica. The recovery was just over 70 percent.

Norwood B. Melcher

Shipments of manganese ore (35 percent or more manganese, natural) from domestic mines are estimated at 76,000 long tons in 1941, compared with 40,123 tons in 1940, according to preliminary figures released by the Bureau of Mines after the foregoing article was written.

The Light Metals

(*Continued from page* 47)

ing placed two 18,000,000-lb. units in operation on the seaboard, and having expanded its annual capacity at its Michigan plant, to 18,000,000 lb. The Permanente Metals Corporation came into production in the fall of 1941, in California, with one 8,000,000-lb. unit. During the first nine months of 1941, the United States imported no magnesium but exported 2,208,552 lb—43 percent more than was exported during the same period of 1940.

The various demands for magnesium were much greater than the supply in 1941. More magnesium was needed for magnesium-base and aluminum-base structural alloys for the aircraft industry and for the manufacture of incendiary bombs. In 1942 the situation should be considerably better, as new Government- and Federal-financed plants, already under construction or authorized, will provide for a large tonnage of metal in addition to the productive capacity that is already being utilized. The six companies identified with present authorized magnesium program are the Dow Chemical Co., Permanente Metals Corporation, Basic Magnesium, Inc., Diamond Magnesium Co., Mathieson Alkali Works, Inc., and International Minerals & Chemical Corporation. Dow employs an electrolytic magnesium chloride process developed by the company since 1916 and uses underground brine in Michigan and sea water elsewhere as its raw materials. Permanente is using the relatively new and revolutionary Hansgirg (or Austrian) electrothermic reduction process; although some difficulties have been encountered, including minor plant explosions, it is now believed that most of the operating problems have been solved. Magnesia for the process is procured from Nevada magnesite and sea water. The four other companies that expect to begin producing magnesium in 1942 probably will employ either the Dow or the Magnesium Elektron modified magnesium chloride electrolytic processes. Dow feeds an almost anhydrous magnesium chloride to its electrolytic cells, whereas Magnesium Elektron utilizes absolutely anhydrous magnesium chloride. The two processes utilize different types of cells and cell baths.

No official data are available on the aluminum and magnesium industries in other countries during 1941, but output undoubtedly was boosted to maximum capacity. The Axis powers of Europe are adequately supplied with large reserves of bauxite and magnesium raw materials, but the situation regarding power, plant equipment, and miscellaneous raw materials probably is not as favorable. The Japanese, on the other hand, control no large deposits of bauxite outside of a relatively small quantity stockpiled, but they have adequate reserves of magnesium raw materials. World production of bauxite, aluminum, and magnesium in 1939 (the last year for which fairly reliable figures are available) and 1941 (estimated) are shown in the accompanying table. Production controlled or dominated by the Axis is compared with that of the Allies.

Of significance are the Axis gains of bauxite reserves and of metal-producing capacity in Europe since the war started in 1939. To the large reserves of bauxite already under Axis control in Hungary and Italy were added those of France, Yugoslavia, and Greece. France also has large alumina-producing facilities. All Axis aluminum-producing countries, particularly Germany, are believed to have substantially increased their production capacity since 1939. It is reported that Germany now has great plans in store for Norway, where works are to be built capable of producing 150,000 tons of aluminum and 10,000 tons of magnesium annually. Norway possesses considerable potential hydroelectric power but must import its bauxite and alumina. The capacity of the Hoyanger alumina plant probably will be increased, but some alumina is expected to be produced in a new plant utilizing Norwegian labradorite as raw material. Numerous small aluminum plants have been constructed in Japan since 1939, and some observers place that country's 1941 output as high as 150,000 tons.

The United Nations also have greatly strengthened their aluminum position since 1939. Bauxite production in the United States, British Guiana, and Netherlands Guiana (Surinam) and aluminum output in the United States and Canada have been doubled and a tremendous expansion program is under way. The U.S.S.R. lost the Dnepr and Volkhov aluminum reduction works in the German invasion of 1941 but retained the Kamensk (Ural) and possibly other recently constructed plants. In 1941 it appears that the Axis and the United Powers produced practically the same quantity of aluminum.

In respect to magnesium output abroad it is said that there are at least five magnesium plants in operation in Germany, probably five in Italy, and four in France. A new plant in Norway, based upon sea water as raw material, is expected to be completed before the end of 1941. Magnesium-producing capacity has been greatly increased in the United States and the United Kingdom since 1939, and further expansions under way are expected to make it possible to wrest domination in this important field from Germany.

THE MINOR METALS

Domestic quicksilver output is highest in decades. Cadmium scores record production. Platinum consumption increases

Metal Economics Div.
Bureau of Mines, Washington, D. C.

GROUPED TOGETHER as the "minor metals" in this review are eight metals, all of which have importance for certain applications despite the term used, whatever the form in which they find their way into service. The authors of the individual summaries are designated in each case.

ANTIMONY—Continued shortage of Chinese metal, accompanied by rising demand, stimulated domestic consumers of antimony to look to Mexican and South American ore supplies. Higher prices resulted from the increased competition; 50 to 55 percent ores quoted at $1.25 to $1.35 per short-ton unit, New York, at the beginning of 1941 were priced at $2.00 to $2.10 at the close of the year. Despite the sharp rise in ore prices, the quotation for domestic metal remained 14c. per pound. A half-cent rise posted in August was quickly withdrawn at the request of the Office of Price Administration. Quotations for Chinese metal were nominal at 16.5c., duty paid, throughout the year. Imports of needle and regulus for consumption were small, but those of antimony in ore were larger, 14,645 short tons having been received during the first nine months of 1941, compared with 15,733 in all of 1940. Mexico and Bolivia continued to be the principal sources of imported ore.

Higher ore prices stimulated domestic mines to some extent, but no sizable increase in output is expected for 1941. Shipments of high-grade ore and antimony-bearing gold and silver concentrates from the Yellow Pine district, Idaho, increased during the year, and a substantial rise is in sight for 1942 as a result of the completion of the new tungsten-antimony concentrator of the Bradley Mining Co. Production at the Laredo smelter was restrained by shortage of ore from Mexico owing to climatic conditions and loss of ore supplies to other consumers.

Although supplies of antimony were scarce throughout the year, no mandatory priorities were invoked by OPM. Some metal was withdrawn from Government stockpiles to relieve shortages. Among the expanded applications is the employment of antimony oxide as a flame-proofing agent applied to tarpaulins and tents.

On Sept. 13, 1941, the Metals Reserve Co. announced that 7,014 tons of foreign (Chinese) and 1,250 tons of domestic metal had been delivered to its stockpile and 19,623 tons of foreign and 1,750 tons of domestic antimony were on order.

T. H. Miller and **T. P. Wootton**

ARSENIC—Domestic production of white arsenic in 1941 probably changed slightly from the record output of 24,983 short tons in 1940. Although smelter activities increased, accumulated stocks of arsenical residues had been treated in 1940, and production in 1941 was largely limited to current byproduct recoveries. The Anaconda Copper Mining Co. increased production of arsenic metal. During the first nine months of 1941, imports of white arsenic were 7,578 tons, or 13 percent less than during the same period of 1940; Mexico accounted for 88 percent; Canada, 9 percent; and Japan, 3 percent. Quotations for white arsenic advanced from 3½c. to 3¾c. per pound in July and to 4c. in August.

Demand for calcium arsenate was so heavy that local shortages developed during the summer of 1941 as Southern cotton fields experienced a very bad infestation of boll weevil, boll worm, and leaf worm. Producers' stocks were virtually exhausted by October. Fruit growers consumed their usual requirements of lead arsenate, but Federal and State agencies employed less arsenicals in killing grasshoppers and Mormon crickets. During the first nine months of 1941, 3,749,115 lb. of lead arsenate and 2,675,097 lb. of calcium arsenate were exported, 93 and 39 percent more, respectively, than during the same period of 1940.

Herbert A. Franke

BERYLLIUM—Imports of beryl in the first nine months of 1941 skyrocketed to a record of 1,635 short tons —942 from Brazil and 693 from Argentina. Such imports in all of 1940 were 805 tons. Prices were unchanged throughout 1941—beryllium ore at $30 to $35 a ton and 4 percent beryllium-copper master alloy at $15 per pound of contained beryllium. A deposit of helvite in New Mexico, carrying about 2 percent Be, received some attention. A new plant for producing beryllium compounds was built during 1941 in Harbor City, Calif., by the Calloy Co. Consumption of beryllium increased substantially during 1941, but little of the advance can be attributed to direct defense needs. There was considerable agitation for Government action to stimulate production of beryllium, but up to the close of the year none had been taken.

Allan F. Matthews

BISMUTH—Although smelters operated at greater capacity, it is believed that 1941 domestic bismuth production declined slightly from the record 1940 output, chiefly because consumers were willing to accept lead containing a higher percentage of bismuth, which removed the incentive for maximum debismuthization. Furthermore, only minor quantities of magnesium, required in one debismuthization process, were available. Demand for bismuth probably doubled in 1941 as its use in metallurgical and pharmaceutical applications increased. Army and Navy medical units increased their consumption of pharmaceuticals containing bismuth, and alloys containing bismuth were used to a greater extent in the aircraft, machine tool, munitions, building, and other industries. Production plus accumulated stocks and imports should be adequate to meet future requirements. During the first nine months of 1941, imports of bismuth metal aggregated 198,162 lb. (all from Peru), the highest ever recorded. In addition, 708,873 lb. of lead alloy were imported from Peru, of which 393,088 lb. were metals other than lead, chiefly bismuth. Nominal price of the metal remained steady throughout the year at $1.25 per pound.

Herbert A. Franke

CADMIUM—Record production, heavy demand, and stable prices characterized the cadmium industry during 1941. Utilization of cadmium in bearings and decorative pigments was discouraged to release larger amounts for plating important equipment and parts. Cadmium has so far escaped control by priorities or direct allocation, but in September producers agreed to submit to the OPM monthly sales lists to assist the Government in advising how to keep current output in the channels of most urgent requirements.

Production of metallic cadmium was boosted about 15 percent to an estimated record of 6,840,000 lb. in 1941, compared with 5,921,488 lb. in 1940. In addition, an appreciable amount of cadmium was converted from primary

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and secondary materials directly into compounds. Shipments of metallic cadmium in 1941 are estimated at 6,720,000 lb., an 8 percent gain over the 6,222,942 lb. shipped in 1940. A new cadmium recovery unit in Texas was put into operation in December by the American Zinc, Lead & Smelting Co. Imports of metallic cadmium in the first nine months of 1941 totaled 147,378, lb., principally from Canada, compared with 27,491 lb. from Belgium in 1940. Domestic production was partly from Mexican and Southwest African flue dusts, imports of which contained 1,707,022 lb. of cadmium in the first nine months of 1941 and 1,890,528 in all of 1940.

The opening 1941 price of 80c. a pound for commercial sticks of cadmium was advanced 5c. on Feb. 17 and March 7 to 90c. a pound, where it remained throughout the year. The average price in 1940 was 79.9c. a pound. As in previous years, patented anode shapes commanded a premium of 5c. a pound. Vigorous action was taken by the Government to restrain sales of cadmium at prices considerably above the ceiling quotations established by the the Office of Price Administration in midsummer.

Allan F. Matthews

COBALT—Imports of cobalt during the first nine months of 1941 comprised 6,631,692 lb. of residues averaging 41 percent cobalt from Belgian Congo, 2,016,105 lb. of ore averaging 8.7 percent cobalt from Canada and Australia, 484,800 lb. of metal from Canada, and 38,002 lb. of oxide from Belgium, Canada, and the United Kingdom. Imports during the entire year 1940 comprised 7,843,828 lb. of residues, 2,653,891 lb. of ore, 130,321 lb. of metal, and 756,759 lb. of oxide. Most of the cobalt-bearing residues are converted to metal at Niagara Falls, N. Y., and to oxide at Cincinnati, Ohio, and New Brighton, Pa. The metal-refining capacity of the Niagara Falls plant is being increased 50 percent. Cobalt oxide was also produced in 1941 at Wilmington, Del., from ore recovered as a byproduct of the iron ore mined at Cornwall, Pa.

Consumption of cobalt, chiefly in the production of high-speed cutting tools and permanent magnets, increased substantially in 1941.

Domestic quotations for metal in 100-lb. lots and for black oxide in 350-lb. lots remained unchanged throughout 1941 at $1.50 and $1.84 a pound, respectively. These prices have been in effect since the latter part of October, 1939.

General Preference Order M-39, issued by the Office of Production Management on Nov. 4, 1941, placed domestic and imported ore and concentrates, cobalt metal, and cobalt chemical compounds under mandatory control and restricts deliveries and acceptances of cobalt for metallic uses to specific authorization by the Director of Priorities.

H. W. Davis

MERCURY—Under the continuing stimulus of high prices, domestic mercury mines were able to supply largely increased demands for most of 1941. Although prices attained a new annual peak, consumption exceeded production during the final quarter. Twice in 1941 high prices were the target for warnings issued by the Office of Price Administration, but probably due to the sharp increase in requirements, to a flattening curve of production, and to restricted possibilities for importation, price action was withheld. Late in the year the Office of Production Management was considering curtailing consumption for certain uses.

Production in 1941 amounted to about 44,000 flasks, the largest since 1883, but consumption exceeded domestic production by probably 1,000 flasks. Favorable factors were the drop in exports from 9,617 flasks in 1940 to 1,932 from January through September 1941, and the resumption of importation. General imports were nonexistent from January to July 1941, but 1,485 flasks were entered in August and September and larger quantities were in prospect as a result of an agreement, reached in July, for purchase by the Metals Reserve Co. of certain strategic commodities, including mercury, from Mexico.

Mexican production in the first eight months of 1941 aggregated 17,927 flasks, greatly above the 11,653 flasks for all of 1940, itself sharply above previous years. Japan received 15,933 flasks of Mexican metal in the first eight months of the year, but this movement was stopped by governmental decree. Canada became an important source of mercury in 1940 and increased its production again in 1941.

H. M. Meyer

TITANIUM—Production of titanium-bearing ferro-alloys increased in 1941, but data are not available for publication. Imports were 313,474,596 lb. of ilmenite and 1,859,986 lb. of rutile in the first nine months of 1941, compared with 443,282,470 and 312,065 lb., respectively, in all of 1940. The price of ferrocarbontitanium remained at $142.50 a ton and metallic titanium at $5 to $5.50 a pound throughout 1941. The ilmenite quotation of $18 to $20 per gross ton of 50 to 60 percent TiO_2 was replaced in February with $28 to $30 for straight 60 percent material. Rutile, 94 percent concentrates, held at 8 to 10c. a pound during 1941, but 88 to 90 percent grades advanced $10 in April to $95 a ton. The shipping situation has curtailed supplies of ilmenite from India, but the situation will be relieved somewhat next summer when ilmenite production of 800 tons daily will be under way at Tahawus, N. Y., by National Lead Co. Titanium dioxide production held close to capacity during 1941, but Army-Navy demands for titanium paints and increased consumption in weld-rod coatings compelled many paint manufacturers to return to the use of white lead. On Jan. 1, 1942, General Preference Order M-44 went into effect regulating the distribution of titanium dioxide.

Allan F. Matthews

PLATINUM METALS—Recoveries of platinum metals by refiners in the United States gained phenomenally in 1941, chiefly as a result of refining concentrates from Canada and crude platinum from Alaska, most of which heretofore was refined in England. Refinery capacity is being greatly in-

YEARLY AVERAGE PRICES MISCELLANEOUS METALS

Year	Aluminum	Antimony	Cadmium	Quicksilver	Platinum
1941	16.500	14.000	(*a*) 88.443	185.023	36.000
1940	18.691	14.000	(*a*) 79.920	176.865	37.924
1939	20.000	12.359	(*a*) 59.180	103.940	36.748
1938	20.000	12.349	98.037	75.469	35.901
1937	19.917	15.355	122.335	90.180	51.773
1936	20.000	12.240	97.789	79.917	42.926
1935	20.000	13.616	70.491	71.992	34.150
1934	23.300	8.901	55.000	73.865	36.465
1933	23.300	6.528	55.000	59.227	30.993
1932	23.300	5.592	55.000	57.925	36.455
1931	23.300	6.720	56.010	87.351	35.665
1930	23.787	7.667	(*b*)	115.009	45.358

Quotations for aluminum, antimony, and cadmium in cents per pound; quicksilver in dollars per flask of 76 pounds; platinum, refined, in dollars per troy ounce. (*a*) Commercial sticks, producers, quotation. (*b*) Not averaged by *E. & M. J.*

creased to refine larger quantities of Canadian concentrates.

Stimulated by defense activities, there were noteworthy increases in consumption of platinum metals in 1941, chiefly in the chemical and electrical industries. Consumption of iridium in jewelry dropped substantially, whereas the use of ruthenium for this purpose advanced considerably.

Because of the demand for iridium for use in contact points for magnetos, voltage regulators, and other electrical applications in the defense program, the Office of Production Management on July 3, 1941, requested the voluntary cooperation of refiners and others in discontinuing the use of iridium in platinum alloys for jewelry articles and to substitute 5 percent ruthenium-platinum alloys. However, effective Dec. 12 the use of iridium and its alloys in manufacture of jewelry was prohibited under conservation order M-49.

Imports of platinum metals during the first nine months of 1941 were 215,069 oz., compared with 195,645 oz. in the entire year 1940. Exports of platinum metals (ingots, sheets, wire, alloys, and scrap) during the first nine months of 1941 were 13,388 oz., compared with 55,027 oz. in the entire year 1940.

Throughout 1941 platinum was quoted at $36 an ounce, palladium $24, osmium $45 to $48, rhodium $125, and ruthenium $35 to $40. Iridium was quoted at $275 an ounce during January and at $175 the remainder of the year.

H. W. Davis

Outstanding in platinum metals during 1941 was the growth in the application of metals in this group by industry, according to Charles Engelhard, president of Baker & Co., in his annual review of the industry. He points out that platinum is used as a catalyst in producing nitric acid and much of contact sulphuric acid. Palladium is being used increasingly as a catalyst in the hydrogenation of organic compounds and in various other processes. Palladium catalysts permit the use of lower temperature and pressure than catalysts made of the base metals.

Glass wool fiber for insulation and other similar purposes is made from molten glass which is passed through small orifices in platinum metal alloy feeder dies. Platinum is used on the exposed surfaces of insoluble anodes for producing electrochemical products, such as potassium perchlorate and persulphuric acid. Platinum-clad metals are being employed more extensively in the chemical industry.

Electrical contacts of platinum alloys are required in instruments and equipment for our fighting forces. Thermocouples of platinum and platinum-rhodium alloy are used in temperature-control and other instruments.

Use of platinum and palladium as alloying elements with gold continues to gain in favor chiefly for dental purposes.

Lead

(*Continued from page* 45)

The ordinary incentive to increase domestic production of lead—a higher price—has been lacking owing to the pressure informally placed by the Office of Price Administration on the price of lead, keeping it at 5.85¢ per pound from April to the end of 1941, despite rising costs of labor and materials. The Government has relied principally upon exhortation to produce more lead from domestic mines. Mines in the West had been operated on the statutory 40-hour week to avoid overtime penalties. After the country entered the war in December many of the Western mines immediately increased production by operating six days a week, regardless of the consequences to their operations, or their own views. This should increase mine production from 40,000 tons per month in 1941 to perhaps 45,000 tons per month. But the marginal and low-grade ore properties have not begun operations and need a better market to do so.

There is a prospect that more lead might be obtained from Mexico if the foreign price were increased. This metal will be needed if Australian deliveries are interrupted by virtue of the war in the Far East.

Imports of lead are being made almost exclusively by the Metals Reserve Company through direct negotiation with foreign producers, and purchases are disposed of by the Tin-Lead Branch of the OPM upon application by consumers. In addition to allocating foreign supplies, the OPM has been allocating a cut of the production from domestic mines, amounting generally to about 15 percent monthly. In effect, then, the Government has been controlling the distribution of about 45 percent of the available supply. The OPM receives a monthly record of sales by lead refiners to help in its job of allocating equitably the lead under its jurisdiction. Lead disbursements made by the Government in 1941 ranged from 25,000 to 35,000 tons of the metal per month.

The principal outlets for lead during 1941 were, as usual, cable sheathing, storage batteries, and white lead. Cable consumption will probably amount to 160,000 tons, the highest since 1930 and reminding one of the period when it consumed about 200,000 tons per year. The storage battery industry used up probably 250,000 tons of lead in all forms, including scrap and litharge, in 1941. White lead and red lead had to carry the ball for the paint industry owing to the shortage of other pigments derived from aluminum, zinc, and titanium. Making extremely durable paints, they will help defense by economizing on men and materials for essential painting. About 120,000 tons of white lead, dry and in oil, and 50,000 tons of red lead were sold in 1941, an increase of 30 percent and 17 percent, respectively, over 1940.

Tetraethyl lead, which has become an important outlet for lead and plays an indispensable rôle in aviation gasoline, required about 50,000 tons of lead in 1941, and could use more in 1942 if available.

The foil industry, deprived of its customary aluminum, turned to lead as an alternate and after consumption grew month by month to over 5,000 tons per month, the OPM issued a drastic conservation order, practically extinguishing the use.

Unfortunately, there is no clear indication today of what additional tasks will be expected of lead now that the United States is actively at war. The use of lead in ammunition will grow, but this may be offset by decreased civilian use, possibly in residential construction and other applications. For example, there is the impact on lead caused by the shortage of rubber. Does this mean a lighter load on lead from the automobile industry and a heavier one from the chemical industry? Moreover, the prohibition on the manufacture of new automobiles will diminish the demand for lead. To sum up, so many variables are at work on lead today that the future is too uncertain for any predictions. Suffice it to say that lead will continue to be an indispensable metal for the emergency. Every pound that can be produced will find a job to do.

Copper

(*Continued from page* 43)

was announced by the Division of Priorities on Oct. 20.

Private estimates on probable consumption of copper for the duration of the war are of little or no value. The problem is too big. The use of copper in modern mechanized warfare is much greater than in World War I—that is certain. How the copper-deficient Axis will handle its copper problem after reserve stocks have been depleted remains a mystery to most observers here. However, the United States intends to use copper as never before in prosecuting the war to a successful conclusion and it has been hinted that close to 5,000,000 tons of the metal will be needed over the next two years to do the job.

Tin

(*Continued from page* 45)

warnings were issued before this step was taken by the Office of Price Administration. The first warning was sounded in February 1941, at which time political tension in the Far East caused a flurry in buying and sent the price up to 54¼c., New York. Another came in July, when a nervous spell struck the market on the occasion of Japan's entry into Indo-China. Though the general public may not have been greatly disturbed about developments in the Far East, the tin industry was in constant fear of possible interruption of shipping because of Japan's actions, which spoke louder than words.

In announcing the maximum prices for tin on Aug. 15, Leon Henderson, Price Administrator, declared: "This action is necessary because the current situation in the Far East, from which the United States imports almost all of the metallic tin used in this country, makes uncertain the continuance of an adequate supply of this strategic metal. An increased demand, accompanied by a fear of a decrease in supply, has already had an inflationary effect upon the price of tin and threatens to exert even greater inflationary pressure in the future."

The maximum price schedule on the more important grades of tin, in cents per pound, follows:

Grade:	Maximum Price
A. 99.80 percent or higher	52.000
B. 99.75 to 99.79 percent	51.625
C. Cornish refined	51.625
D. 99.00 to 99.74 percent	51.125
E. Below 99 percent	(*a*) 51.000

(*a*) For tin content.

The price situation outside of the United States presented no great problem over the first half of the year, in which period the buying of tin by Metals Reserve and United States consumers governed the market. After the Axis moved against Russia, that country again entered into the ranks of buyers, operating through Singapore. This buying raised the price of tin in that important tin market to above United States parity and hindered dealers and consumers from operating freely. The war in the Far East brought almost immediate suspension of trading in both Singapore and London. The last quotation for 1941 was posted by the London Metal Exchange on Dec. 8, on which day Standard on spot was £259 per long ton, and the three-months' position £262.

The general uplift in business, together with a wave of protective buying against an uncertain future, raised tin consumption sharply. Under normal conditions, the United States consumes from 70,000 to 75,000 tons of virgin tin a year. During 1941, however, tin disappeared in the United States at the rate of 97,000 tons a year.

Deliveries of foreign tin in the United States kept well ahead of the use of the metal, indicating that stockpiles were enlarged. Deliveries during 1941, according to the Commodity Exchange, totaled 143,342 tons, which compares with 115,339 tons in 1940 and 71,896 tons in 1939. Deliveries dropped in the final quarter of 1941, which was interpreted in some directions as being a reflection of the control measures that were forced on the trade.

Talk of erecting a tin smelter in the United States was finally translated into action. Federal Loan Administrator Jesse H. Jones announced on Feb. 26 that a Government-sponsored tin smelter is to be built somewhere in Texas by the Tin Processing Corp., a subsidiary of Billiton. The company will build the plant on a fee of 4 percent and operate the smelter on a fee of 1 percent of the value of tin produced. The cost of the project was estimated at $3,500,000. During May, a contract was awarded to Ford, Bacon & Davis, Inc., for construction of the smelter.

Though the tin smelter is not expected to get into production before April, 1942, tin concentrate importations in 1941 came through on a fair scale. Up to the end of September, the tin content of the concentrate imported was 16,570 tons, mostly from Bolivia. The Dutch interests concluded an agreement with Metals Reserve Co. during August to ship concentrate from the East Indies containing about 20,000 tons of fine tin. How much of this concentrate will arrive here for treatment at the new smelter in Texas is uncertain, owing to war conditions. But high-grade concentrate will help sweeten the batch and reduce smelting costs, as much of the Bolivian concentrate contracted for consists of rather low-grade material.

Because of developments in the Pacific, Federal Loan Administrator Jones informed the press soon after the turn of the year that the capacity of the smelter referred to will be increased.

At a meeting of the International Tin Committee, held in London Dec. 1, 1941, the question of continuing the control scheme for a period of five years, beginning Jan. 1, 1942, was considered. Standard tonnages were raised for all signatory countries except Thailand (Siam). The governments of Bolivia, the Belgian Congo, Netherlands East Indies, Nigeria, and Malaya accepted the new standard tonnages recommended by the Committee and agreed to the extension of the scheme. However, Thailand objected to the plan.

In a statement issued after the meeting, the Committee said:

"Should the Government of Thailand eventually decline to join in the system of control, the Committee suggested certain alterations in the scheme to safeguard the position of the participating countries."

On the assumption that the five Governments mentioned will approve of the alterations, the Committee fixed the production quota for the period from Jan. 1 to June 30, 1942, at 105 percent of the new standard tonnages. The standard tonnages proposed, compared with those in the old agreement, in long tons, follow:

	Old	New
Belgian Congo	15,035	20,178
Bolivia	46,027	46,768
Malaya	77,335	95,474
Netherlands E. I.	39,055	55,113
Nigeria	10,890	15,367
Thailand (Siam)	18,628	18,500
Totals	206,970	251,400

Throughout 1941, the production quota was maintained at 130 percent of standard tonnages.

It became public knowledge last June that the Patiño interests stood ready to build a smelter in this country should an emergency arise. Pending further developments in the Far East, conservation of supplies will have to be practiced during the year 1942 in earnest.

WORLD'S TIN PRODUCTION — In Long Tons

Country	1938	1939	1940	1941
Bolivia	25,371	27,215	37,940	40,250
Great Britain	1,999	1,800	(*a*) 1,800	(*b*)
China	11,000	11,000	(*a*) 10,000	(*b*)
Burma	4,950	5,400	(*a*) 5,400	(*b*)
Malaya	43,247	55,950	85,384	78,000
Thailand (Siam)	13,520	16,991	17,416	16,250
Netherlands E. I.	21,024	31,281	44,563	51,000
Nigeria	7,305	10,855	10,257	13,500
Belgian Congo	7,318	9,663	12,392	14,000
Australia	3,329	3,500	(*a*) 3,500	(*b*)
Elsewhere	9,568	9,986	9,148	(*b*)
Totals	148,631	183,641	237,800	239,000

Production of tin on ore basis. Figures for 1938, 1939 and 1940 by American Bureau of Metal Statistics; 1941 *E. & M. J.* estimates. (*a*) Conjectural. (*b*) Not available.

GOLD

Production of precious metal slows down as difficulties mount in getting needed labor, equipment and supplies

By a correspondent
Washington, D. C.

RATE OF INCREASE in gold output declined sharply in 1941. It amounted to less than 1 percent, compared with more than 5 percent in 1940, nearly 7 percent in 1939, and a near-record increase of 9 percent in 1938, as shown in Table I.

The abruptness of the decline suggests that it reflects more than a further tapering off in the expansion of gold output that was stimulated in the early 'thirties by the higher prices paid for gold by governments throughout the world. The additional factor is undoubtedly the difficulty faced by the gold industry everywhere in competing with war demands for equipment, materials, and labor. Manufacture of machinery required for processing gold ore, and of mine cars and track, utilizes industrial capacity, steel, and other metals which are vitally needed for armament—either for the creation of new plant or for the direct manufacture of military equipment. Prices have been driven up and taxes have been imposed, raising the cost of operation. New investment in gold mining has diminished in attractiveness. But there has been a more direct factor. Under pressure of the war effort both the British and American Governments have refused to allocate resources for the manufacture of equipment for gold mines as yet unopened. As the United States and the United Kingdom are the principal producers of such equipment, this policy would affect the exploitation of gold fields throughout the world.

Supply of equipment and materials for active gold mines has also been restricted, but it is doubtful whether this has yet forced extensive curtailment in the scale of operations. With the United States in the war, however, the establishment of a joint policy of the United Nations with respect to supplies, and increasing indications that nothing short of all-out effort will be acceptable, there can be little doubt that allocations of machinery and steel products generally for the use of the gold mining industry will be made with increasing reluctance. Where this policy affects only such factors as replacements of mine cars and rails, the effect on gold output will probably be hardly noticeable. But inability to obtain steel balls for the ball mills, repair parts for prime movers and machinery, and perhaps chemicals, fuel, and other materials, would force a reduction in the tonnage of ore processed. Though this might result in some increase in the average grade of ore mined, to maintain dollar (or sterling) revenue at the supposed "optimum" level in relation to plant investment and ore reserves, and so forestall a sharp reduction in gold output, it seems probable that gold production in 1942 will, for the first time in many years, show a drop as compared with the previous year.

In fact, it is quite possible that this reduction may reach unprecedented proportions as a result of positive action taken by the British and American Governments.

Developments of the past year have demonstrated without doubt that gold now has no rôle to play in the war effort. In 1940 the gold reserves and new gold production of the British Empire (and, for a time, of France) constituted, together with their dollar assets, the sole means of paying for the additional imports from the United States which they needed to carry on the war. By the early part of 1941 these assets were largely exhausted, or held against orders already placed, as shown in Table II. It was this fact that rendered passage of the Lend-Lease Act necessary; and it was passage of this Act that removed the last possible argument that gold had a rôle to play in the war.

Since passage of the Lend Lease Act the flow of gold to the United States has slackened notably. The output of Canadian mines is still being sold in the United States, and constitutes the principal source of foreign metal, although there has been a good deal of speculation in the press as to whether this situation would be allowed to continue. Canadian production amounts to about $185,000 000 a year, roughly equal to output in the United States. Gold produced in Mexico, South America, and Australia is also being sold here. These foreign sales, together with United States production, are increasing the United States gold stock at the rate of about

Table I—World Gold Production

Source: *Federal Reserve Bulletin*

(In millions of fine ounces)

Principal gold producing countries	1941 (*a*)	1940	1939	1938
North America	13.3	13.1	12.4	11.5
United States (incl. Philippines)	6.2	6.0	5.6	5.1
Canada	5.4	5.3	5.1	4.7
Mexico	0.8	0.9	0.8	0.9
South America	0.9	0.9	0.9	0.8
Colombia	0.6	0.6	0.6	0.5
Chile	0.3	0.3	0.3	0.3
Africa	16.3	16.0	14.7	13.9
South Africa	14.3	14.0	12.8	12.2
Rhodesia	0.8	0.8	0.8	0.8
West Africa	0.9	0.9	0.8	0.7
Belgian Congo	0.3	0.3	0.3	0.2
Asia and Oceania	1.8	1.9	1.9	1.9
Australia	1.5	1.6	1.6	1.6
British India	0.3	0.3	0.3	0.3
Total, principal countries	31.2	31.1	29.1	27.3
Other countries (*b*)	5.5	5.3	5.6	5.2
World totals (*b*)	36.7	36.4	34.7	32.5
Percentage increase over previous year	0.7	5.2	6.7	9.1

(*a*) Preliminary.

(*b*) Excluding Russia, for which no data available since 1938, when output was estimated at 5,250,000 oz.

$500,000,000 a year. The gold stock increased about $900,000,000 in 1941, to $22,800,000,000. The increase in 1940 was $4,350,000,000 and that in 1939 was $3,100,000,000.

South African gold is no longer being marketed in the United States, but is being used to replenish South African and British reserves. Though the Lend-Lease Act has made this possible, the difficulty, inconvenience, and danger of transporting substantial quantities of gold over long distances and through submarine infested waters was undoubtedly an important factor in the decision not to sell South African gold. Arrangements have also been made with Russia to obviate the necessity of shipping gold. The first Russian purchases here were financed by advances against gold or the sale of gold. Several shipments were made; but, although Russia has been producing $150,000,000 to $200,000,000 of gold a year according to the best estimates, and is thought to have had more than $1,000,000,000 of reserves, it was found much more practicable to extend Lend-Lease aid to the Soviets. Book credits are not subject to enemy attack.

The logic of this situation suggests that the British and American Governments may not be content to see equipment, materials, power, and labor utilized in the production of useless gold when they could be diverted to producing the ores of strategic metals—chromium, tungsten, copper, manganese, and so on. Such a diversion could take place fully as easily as many that have been and are being forced on industry: for example, the use of automotive and locomotive plant, equipment, and labor for the production of planes, tanks, and guns. Shift foremen and common laborers in the gold mines could learn in less time than other laborers would require whatever peculiarities the mining of other ores might have; and pumps, piping, drills, hand tools, mine cars, track—virtually all except the most highly specialized equipment—could readily be used in and transferred to other types of mines. The saving in electric power would also be considerable.

Opportunities would vary from country to country, district to district. Nor is it meant to imply that no obstacles exist. Certain types of equipment built for the relatively small-scale operations of certain gold mines could not be effectively integrated into a mine plant of much larger capacity. Technical problems like this would undoubtedly be encountered, and special solutions would need to be worked out. It would also be necessary to protect the rest of the community against the unwanted repercussions of the shift from gold into other types of mining. These and other factors would prevent anything like 100 percent diversion; but diversions of from 10 to 50 percent in areas subject to Anglo-American control should not prove impossible, and might well make the difference between an adequate and an insufficient supply of certain strategic metals. Shortage of labor which could be supplied from the Witwatersrand, is already said to be inhibiting the production of chromite in Rhodesia.

One of the special appeals of such a program would be that, unlike the diversion of automotive or locomotive plants, it would involve no sacrifice by individual or industrial consumers of the peacetime product. On the contrary, it would please the increasing number of those who feel that the continued purchase of gold by governments is an unnecessary and costly concession to outmoded monetary theories.

The only serious objection, probably, would come from the gold industry itself. Before the declarations of war on the United States by the Axis

(*Continued on page* 56)

Table II—Gold and Dollar Resources of the United Kingdom, 1939-1941 (a)

	Amount Held Aug. 31, 1939	Amount Available (b) Dec. 30, 1940
	(In Millions of Dollars)	
Gold	2,038	241
Dollar assets (c)	2,445	1,570
Total	4,483	1,811
Obligations under orders outstanding Jan. 1, 1941		1,274
Available for other requirements		537
Estimate of other requirements for 1941 — net		190

(a) Official figures. See *Federal Reserve Bulletin*, February, 1941.

(b) Additional holdings of $51,000,000 of gold and $305,000,000 of deposits regarded as unavailable for various reasons.

(c) Deposits in banks; securities of various kinds; and real property, including industrial concerns, of uncertain liquidating value.

SILVER

Market steady. World output up 800,000 oz. New uses possible

● **Dickson H. Leavens**

Cowles Commission for Economic Research

DURING THE YEAR the silver market was steady, with the New York official price at 34⅞c. per ounce until Nov. 28, when it was raised to 35⅛c. The London price has usually been at or just below 23½d. per ounce, at which the Government of India was ready to sell. The United States Treasury has continued to pay 71.11c. per ounce for newly mined domestic silver in accordance with the act of July 6, 1939, and to purchase foreign silver at 35c. as during the last two and a half years.

The London price has been about 23 percent above parity with New York, and the Bombay price has been about 19 percent above parity with London. These great discrepancies arise from the fact that these three markets are insulated from each other by wartime restrictions on the free movement of the metal.

World production in 1941 amounted, according to the latest estimates, to 274,500,000 fine ounces, an increase of 800,000 oz. compared with 1940. United States production of 68,500,000 oz. may be compared with 67,000,000 in 1940 and with the all-time peak of 71,000,000 in 1937. Output has been stimulated by activity in the production of other metals of which silver is a by-product, in the course of prosecuting the emergency program.

No extensive "other supplies" of silver came on the market during 1941. Two and one-half million ounces, probably originating in China, have come out of Japan. The Government of India has not released much information about its stocks of silver, but probably has not made any extensive sales during the year. United States imports have amounted to about $40,000,000 or around 120,000,000 fine ounces.

China is now almost entirely out of the silver picture. For the last three years her exports of the white metal have been negligible in comparison with the flood of over a billion ounces which came out of the country in the years from 1933 to 1938. She is using

WORLD'S SILVER PRODUCTION — In Fine Ounces

Country	1938	1939	1940	1941
United States	58,736,000	57,808,000	67,013,000	68,500,000
Canada	22,219,195	23,163,629	23,815,715	20,435,000
Mexico	81,016,939	75,868,824	82,638,167	81,000,000
Peru	20,552,177	18,802,226	19,000,000	19,000,000
Other America	17,828,731	18,786,901	17,023,450	18,000,000
Europe	22,231,166	21,805,005	22,000,000	(a)
Australasia	15,102,405	15,536,875	15,600,000	(a)
Japan	10,000,000	11,000,000	11,000,000	(a)
India	6,450,000	6,830,000	6,800,000	(a)
Other Asia	4,325,653	4,556,996	4,200,000	(a)
Africa	5,618,768	4,618,209	4,600,000	(a)
Totals	264,031,034	258,776,665	273,690,332	274,300,000

Refinery output. Figures for 1938 and 1939 by American Bureau of Metal Statistics; 1940 and 1941 *E. & M. J.* estimates. (a) Not available.

paper currencies, which pass at only about 20 percent of the value of the former silver yuan. Although silver was "nationalized" by the government in 1935 and its circulation forbidden, it is still used clandestinely for some purposes such as land transactions.

Near the end of December, 1940, the Government of India announced that the fineness of the rupee would be reduced from the standard of 11/12 which had been in effect since 1835 to 0.500; the weight remained unchanged at 1 tola, or 180 grains. This step, the effect of which reached the United States early in 1941, marks an epoch in the history of Indian currency. As regards the world silver market, it is just one more step in lessening the demand for the white metal. The Indian Government should have ample supply for war and post-war needs, and eventually might even have surplus silver to dump in the market.

Mexico continued to be the largest producer of silver and, as such, greatly interested in its price. The importance of our relations with that country has led the United States administration in recent years to oppose repeal of the purchase of foreign silver. Direct purchases from the Mexican Government had been stopped in March, 1938, after Mexico expropriated American oil properties. An agreement was finally consummated on Nov. 19, 1941, for the settlement of oil claims, and the United States Treasury agreed to resume purchases of newly mined silver from the Mexican Government to the extent of 6,000,000 fine ounces per month, at the Treasury's current daily price.

If this agreement should be carried out in full, there would be insufficient silver available in the American market for domestic arts and industries. Newly mined American silver is all taken by the Government, and silver from some of the producing countries in the Eastern Hemisphere is not readily transportable to the United States in wartime. At least part of the Mexican production is, therefore, needed. Handy & Harman accordingly raised the New York official price from 34¾c. to 35⅛c. on Nov. 28, 1941. It is expected that this price differential will be sufficient to attract to the domestic silver market all the Mexican silver that is needed; the remainder will go to the United States Treasury at 35c. per ounce.

United States Treasury purchases during 1941 amounted to about 70,000,000 ounces of domestic and 70,000,000 ounces of foreign silver. The silver in the monetary system on Dec. 31 amounted to about $2,500,000,000. If to this are added the silver bullion held at cost in the general fund and the potential seigniorage thereon when written up to the monetary value of $1,29+ per ounce, the total is $4,250,000,000 or 16.0 percent of the combined value of silver and gold, as compared with the 25 percent set as a goal by the Silver Purchase Act of 1934.

Although the bulk of the silver in our monetary system is held in the vaults as a reserve (and a reserve of little real value) against silver certificates, the subsidiary coins are in active use. The total of dimes, quarters, and halves has increased from $424,000,000 on Dec. 31, 1940 to $500,000,000 on Dec. 31, 1941. This may be compared with a stock of only $307,000,000 on Dec. 31, 1932. Practically all of it is in circulation. The per capita circulation of this form of currency has increased from $2.45 on Dec. 31, 1932, to $3.11 on Dec. 31, 1940, and $3.60 on Dec. 31, 1941. The mints are working 24 hours a day to supply the need for silver subsidiary coins as well as for nickels and pennies. This great demand for small money is due to increasing industrial activity and employment, rising wages and prices, the extensive use of coin-operated machines, and the prevalence of sales taxes. The demand may be expected to contnue to increase.

Little attempt was made during 1941 to modify the United States silver policy, although it is rather generally admitted to be unwise. The Federal Reserve System, in a report released Jan. 1, 1941, recommended, among other monetary proposals, that further monetization of foreign silver should be stopped and that the power to issue silver certificates against the huge stock of silver not yet placed in the monetary system be repealed. This report, however, was sidetracked.

New industrial uses of silver received some attention during 1941. One was the substitution of silver for tin in solder, which was claimed to be economically possible at current prices. Another was the use of silver for busbars and large conductors in the new aluminum and magnesium plants, thus economizing the use of copper; it was suggested that the Government might loan silver for this purpose, to be returned after the war.

The entrance of Japan into the war will result in shutting off or greatly reducing imports of tin from Malaya. This is very likely to force at least some employment of silver for solder, plating of food cans, and other uses in which it can be substituted for tin without too great increase in cost. In the first World War, silver was important as a monetary metal. In the present war it may attain a new, even if temporary, prominence as an industrial one.

Gold

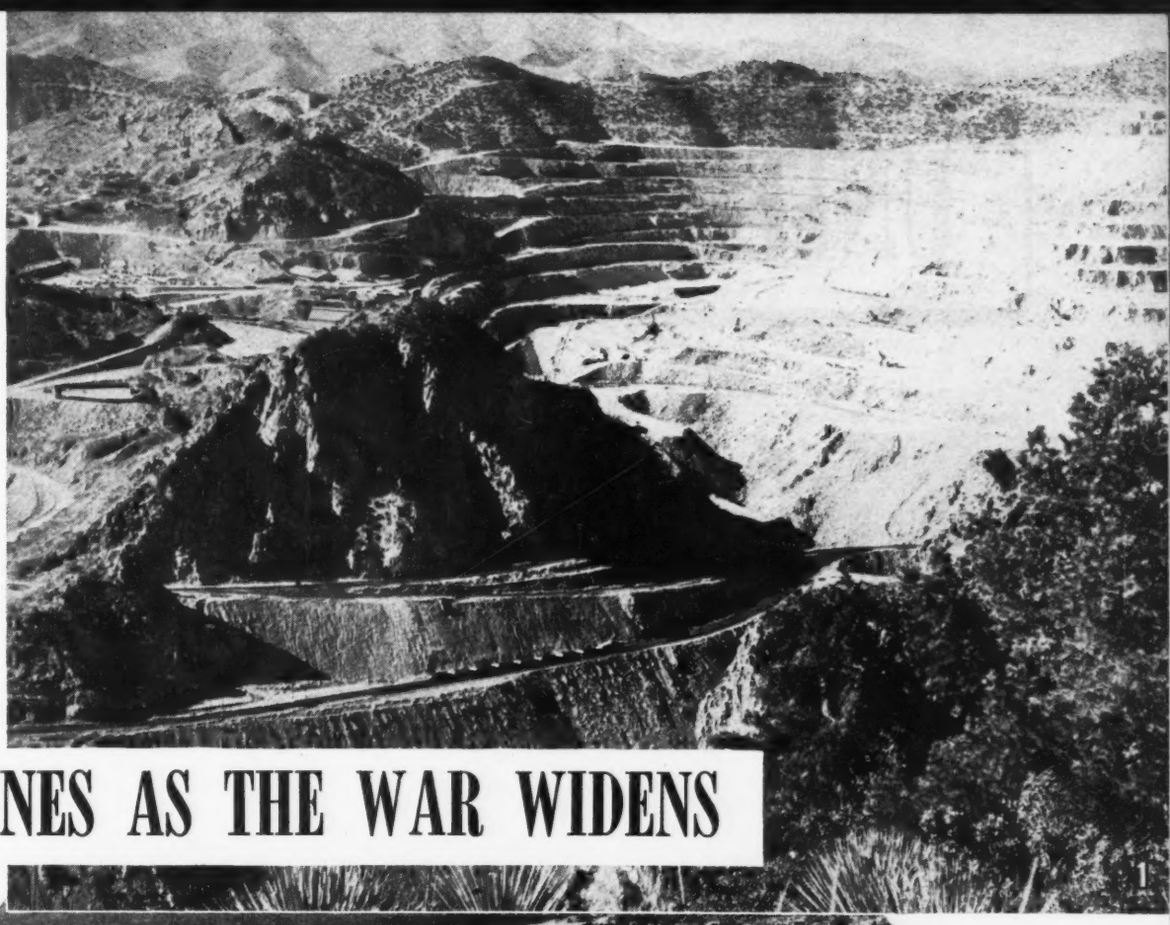
(*Continued on page 55*)

powers, such objections might have been heeded. It may now be expected, however, that no group, either in the United States or the Empire, will be granted exemption from sacrifice. Thus far the gold industry has been in that position; in fact, the sterling price of gold was raised immediately on the outbreak of war in 1939, and it is not believed that the entire benefits of this windfall have been taxed away.

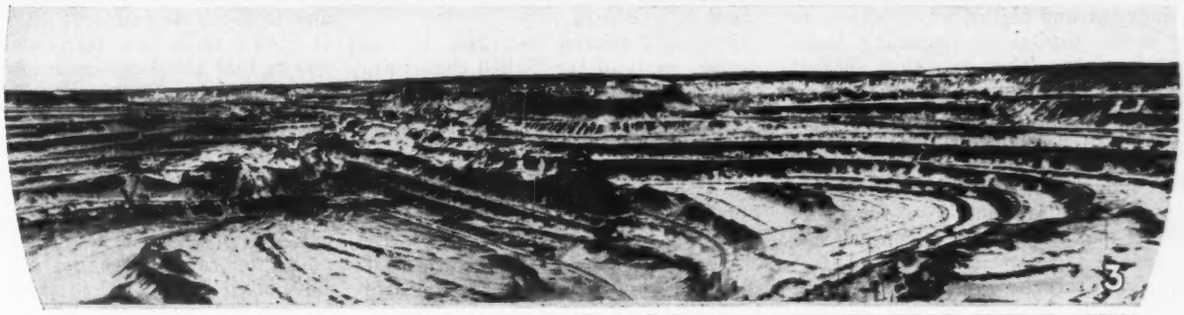
Taking a somewhat longer view, it would perhaps be short-sighted for the gold industry to oppose diversion. Belief in restoration of the fixed gold standard now seems to be dead in nearly all informed quarters. The position of gold, and of the gold industry, in the post-war world, is clouded in uncertainty. Would it not be better for the industry to accept now a war-time development that would perhaps ease its problems of adjustment in the years to come?

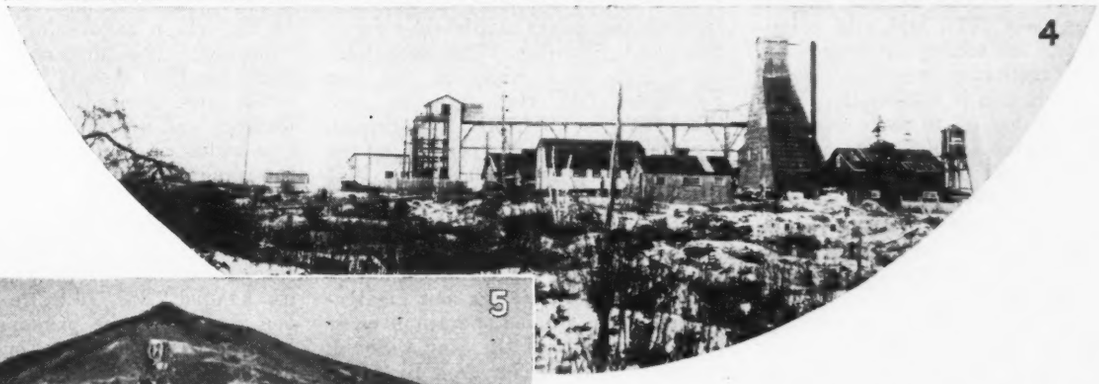
E. & M. J. Metal Prices for 1941 by Days, Including Monthly Averages are on pages 99-100

AT THE MINES AS THE WAR WIDENS



Efforts bend toward greater metal output. 1, The recently opened copper mine of Phelps Dodge Corporation in Arizona





2, New lead-zinc flotation plant of Combined Metals Reduction Company in Nevada. 3. The great Mesabi range leads the Iron Country in increased production—the Hill-Annex pit in Minnesota. 4. Canada turns out more base metals, likewise more gold—here is one of Ontario's new gold producers. 5. Latin America's storehouse is drawn upon—Bolivia's famed "rich hill of Potosi," once mined for silver, now yields tin

UNITED STATES

Effect of war and priorities brings drop in gold output. Base-metal mines assured of equipment for maximum production

H. C. Chellson

Associate Editor

METAL OPERATORS found themselves in an industry subject to many hectic new experiences during 1941, and they became mindful of readjustments that followed the pattern of World War I. Production of copper, lead, and zinc increased, but under circumstances marked by labor difficulties, higher taxes and operating costs, the attraction of mine labor to higher-paid defense jobs, and obscureness surrounding metal prices that remained frozen only slightly above the averages for 1940. Controlled metal prices restricted extensive mine development and chilled any enthusiasm to invest capital in reopening base-metal mines. This condition showed signs of improving, however, during the second half of the year, when the government became fortified with convincing operating facts submitted by the industry. Washington officials moved to raise quotations for some metals and to consider a general rise in 1942 for new production above 1940 figures. Early in January 1942 these new prices became known (details given on page 107), and with priorities control for mining equipment and supplies functioning exceptionally well for the industry, it follows that base-metal mines are off to make new production records in 1942. At present there exists one uncertainty—that of sufficient man power available for employment in the mines to reach the desired output on a three-shift, seven-day week basis. Operators are carefully appraising this situation and are upgrading men as rapidly as possible. Management personnel of old and new mines seeking rehabilitation and reopening of properties have available ample mechanized mining equipment at their command to carry on new work; therefore the outlook for most of the year is viewed with confidence as far as supplies of copper, lead, and zinc are concerned.

Gold mining began to feel the first pinches of the war economy in 1941, particularly during the last half of the year, when priorities control on mining equipment failed to consider effectively gold placer mining operations and lode mines employing fewer than ten men. Small gold producers gradually shut down, and it is expected this trend will increase in 1942. Domestic gold output was about 200,000 oz. less than in 1940 and silver production dropped about 5,000,000 oz.

Principle mining activities in the various parts of the United States are herewith briefly summarized, together with statistics released by the Federal Bureau of Mines.

ARIZONA—When copper production is high in Arizona it always follows that gold output for the State also shows a substantial increase. Of the total 315,000 oz. gold produced in 1941, about 42 percent was recovered from copper mines at Bisbee, Jerome, Ajo, and Superior. The remainder came from lode mines in the San Francisco, Old Hat, Weaver, and Black Canyon districts. The Bureau reports that about 90 percent of the gold produced from placers in 1941 was recovered by dragline plants on Big Bug and Lynx Creeks in Yavapai County. A new 2¼-cu.yd. dragline and floating washing plant equipped with nine Pan-American jigs and amalgamation plates started operations early in January 1941 at the Star & Shank property near Mayer, on Big Bug Creek.

Silver increased, principally due to the higher copper output. The Verde and Ajo copper mining districts accounted for the major part of the increase. Total production in 1941 was 7,551,000 oz., against 7,075,215 oz. in the previous year.

Copper production increased 18 percent in 1941, totaling 332,750 tons, against 281,119 tons in 1940. This was greater than any year since 1929. The State's highest output for a yearly average of a six-year period was 355,600 tons, with output in 1929 at 415,314 tons. The new Morenci unit of the Phelps Dodge Corp. is expected to provide a material increase during 1942.

Lead production in 1941 was the highest in the State's history, with 16,275 tons produced, against 13,266 tons in 1940. Steady operation at the Trench-Flux, Tennessee Schuylkill, and Mammoth-St. Anthony mines and at several zinc-lead properties accounted for the substantial gain.

Seven properties accounted for the largest zinc production recorded for the State, a total of 16,000 tons, compared to 15,456 tons in 1941. The Bureau of Mines reports that the output of ore and old tailings in 1941 was about 25,050,000 tons, an increase of 3,477,800 tons from the figures for 1940. Most of the gain was in copper ore from the Ajo, Globe-Miami, Copper Mountain (Morenci), Ray, Verde, and Warren districts. The total output of copper ore increased from 20,284,826 to about 23,700,000 tons. There was also an increase in output of zinc-lead ore and zinc-copper ore, but a decrease in siliceous gold ore and gold-silver ore.

CALIFORNIA — Gold production declined in 1941. This was principally due to the year-end drop in receipts at custom mills from many small producers that could not maintain operations as labor costs and taxes increased and equipment for gold mining became more difficult to obtain. The State remained the largest gold producer in the country, with output indicating 1,411,800 oz., against 1,455,671 oz. in 1940. The smaller gold placer operations are not effectively considered by priorities; therefore it is expected their operations will not be in such a favorable position for expansion. The Bureau of Mines reports for 1940 showed that 198 properties were worked by 106 dragline dredges, and a preliminary survey of this industry in 1941 indicates that the rapid expansion for the industries is coming to a close.

Silver production was lower in 1941, declining about 9 percent from the total in 1940. Output was 2,147,000 oz., against 2,359,776 oz. in the previous year, with the principal producing area found in Kern County. Most of the silver, however, was derived as a byproduct from gold mining.

California's copper producer, the Walker mine, suspended operations in November 1941, leaving the State to

report 3,905 tons of copper produced during the year, against 6,438 tons in 1940.

COLORADO — Diversified mineral production in this State showed both declines and increases during 1941. The increased gold output is due to increased placer operations in Park County and the zinc-lead increase can be attributed to the bringing into production of the zinc-lead orebodies of the Eagle mine, at Gilman. Production of molybdenum, tungsten, vanadium, manganese, and fluorspar also increased over the 1940 record. Copper production declined in 1941 as well as in 1940. The drop is sharp in 1941, however, due principally to suspension of exploiting a copper ore deposit in Eagle County, and increasing zinc ore output from the same mine where two such distinct types of deposits exist.

The estimated value of Colorado's gold, silver, copper, lead and zinc output in 1941 is $23,716,115, a decrease of 2 percent from that of 1940, according to the Bureau of Mines. The total value of all mineral production, however, was higher in 1941. Cripple Creek continued to be the major producer of gold, accounting for 35 percent of the State's output. Deeper levels in mines drained by the completed Carlton tunnel in this district may provide a steady output of gold during 1942. Smaller gold producers in Colorado may be forced to suspend operations due to higher operating cost and difficulty in obtaining equipment.

Total gold produced in 1941 was 377,503 oz., against 367,336 oz. in 1940. The new floating bucket-type dredge of the South Platte Dredging Co., together with other placer operations, contributed to an 18 percent increase in gold for Park County, the second largest provider in the State.

The leading copper producer in Colorado in 1941 was the New Jersey Zinc Co. Empire Zinc Division, in Eagle County, that shipped copper-iron-silver-gold sulphide ore about six months of the year. San Juan County was the second largest copper provider. Total output for the State in 1941 was 6,501 tons, against 12,152 tons in the previous year.

Lead and zinc production showed sharp gains. The major increase was in Eagle County, where the New Jersey Zinc Co. started mining its lead-zinc orebodies for the first time in many years. Zinc content of the ore is high, and the county produced 11,358 tons of zinc of the total 15,959 mined in the State. Mines in Dolores County provided the second largest tonnage of zinc. The Shenandoah Dives Mining Co., in San Juan County, treating its own and custom ores was the largest lead producer, with properties in Dolores County second.

IDAHO—Increases in gold, copper, and zinc were reported in Idaho for 1941, but silver and lead declined. The State remained the nation's largest silver producer, however, in spite of the drop in silver output. The value of gold, silver, copper, lead, and zinc produced in 1941 was $41,357,000, against $37,744,393 in the previous year. Production of gold from lode mines and placers was quite evenly divided in 1941, with placer operations contributing 73,800 oz. and lode mines 76,200 oz. Placer operations reported an increase of about 13,000 oz., which accounted for the State's increase, as gold from lode mines declined 5,871 oz. from that of the previous year.

Silver production, from the Sunshine mine, the nation's largest producer, declined 15 percent in 1941, with the total output in the State at 16,605,000 oz., against 17,552,240 in the previous year, or a total decline of about 5 percent.

The Mineral Point mine was chiefly responsible for the 16 percent increase in copper output in 1941, that totaled 3,900 tons, against 3,349 tons in 1940. The Bureau of Mines reports that more than half of this total was recovered from silver ore from the Mineral Point and Sunshine mines, near Kellogg; the remainder came largely from zinc-lead ore producers in the State.

Lead output was 1 percent less in 1941, totaling 103,500 tons, against 104,834 tons in 1940. Decreased output from the Morning mine, at Mullan, was largely the reason for the decline. The Bunker Hill & Sullivan mine was the largest producer, followed by the Morning and Hecla mines.

A 10 percent increase in zinc production during 1941 brought the total to 77,600 tons, the largest in the history of the State, compared to the former record of 70,601 tons in 1940. The Star mine, at Mullan, was the largest producer, followed by the Morning, Bunker Hill & Sullivan, and seven other properties. The Bureau reports that about 2,800,000 tons of ore were produced in the State in 1941, compared with 2,556,687 tons in 1940. Approximately 79 percent of the total in 1941 came from 55 mines in the Coeur d'Alene region; the remainder was mostly gold ore from Valley, Elmore, Idaho, Lemhi, and Boise counties, zinc-lead ore from Blaine and Owyhee counties, lead-silver ore from Custer, Boundary, and Bonner counties, was gold-silver ore from Owyhee County.

MONTANA — Mineral output of gold, silver, copper, lead, and zinc was valued at $57,433,700 in 1941, an increase of 3 percent over the previous figure. Production of gold, silver, and lead accounted for the higher value in 1941.

The decline in gold production was due chiefly from a decrease in lode mines. Total output for the State was 246,500, oz., against 272,602 oz. in 1940, with lode mines providing 182,500 oz., against 208,455 oz. in the previous year. Seven floating connected-bucket dredges operating at Clancy, Emigrant, Helena, Missouri River near Helena, Bearmouth, McAllister, and Norris, produced 35,000 oz. of gold in 1941, against 39,012 oz. in 1940, and dragline dredges accounted for 26,000 oz., compared with 22,691 oz. During the last quarter of 1941, a new 10-cu.ft. bucket-line dredge of the Emigrant Dredging Co. was placed in operation

Principal United States Production of Gold, Silver, Copper, Lead and Zinc

(United States Bureau of Mines)

Mine production of metals in 1940 and 1941 in terms of the recovered and recoverable metal in ounces and short tons. Figures for 1941 estimated.

	Gold, Oz.		Silver, Oz.		Copper, Tons		Lead, Tons		Zinc, Tons	
	1940	1941	1940	1941	1940	1941	1940	1941	1940	1941
Arizona	294,807	315,000	7,075,215	7,551,000	281,169	332,750	13,266	16,275	15,456	16,000
California	1,455,671	1,411,800	2,359,776	2,147,000	6,438	3,905	1,772	3,305	79	390
Colorado	367,336	377,503	9,710,709	7,234,487	12,152	6,501	11,476	12,607	5,060	15,959
Idaho	146,480	150,000	17,552,240	16,605,000	3,349	3,900	104,834	103,500	70,601	77,600
Montana	272,602	246,500	12,361,050	11,304,000	126,391	127,500	23,036	21,750	52,587	55,900
Nevada	383,933	372,300	5,175,928	5,786,000	78,454	78,810	7,499	9,490	11,833	14,630
New Mexico	35,943	28,469	1,407,839	1,359,308	69,848	71,562	3,822	4,565	30,313	37,845
Oregon	113,402	94,600	219,112	276,000	88	99	35	68	.....	.....
South Dakota	586,662	610,223	175,514	166,202	6	.....	7	.....	.....	.....
Texas	312	325	1,326,150	1,105,913	30	5	205	175	.....	.....
Utah	355,494	347,784	12,172,299	11,203,733	231,864	262,577	75,688	69,435	43,788	39,630
Washington	82,136	81,569	365,175	385,290	9,612	8,642	2,555	3,660	11,560	13,987
Wyoming	740	482	114	80	2	3	.....	.....	.....	.....
Central States	5	.....	353,737	423,990	45,883	47,595	207,587	208,730	244,976	273,923
Eastern States	18,456	22,000	102,825	105,262	12,745	13,453	4,831	5,500	178,815	190,000
Alaska	755,970	659,086	191,679	191,000	55	10	779	696	.....	.....
Totals	4,869,949	4,717,641	70,549,362	65,844,265	878,086	957,312	457,392	459,756	665,068	735,864

in the Emigrant Creek district of Park County. The West Mayflower mine, operated by the Anaconda Copper company, was the largest gold producer in the State.

A decline in silver production amounting to 9 percent in 1941 resulted mostly from a suspension of operations in April at the Comet-Gray Eagle group of mines, near Basin, by the Basin Montana Tunnel Co., and to a decrease in shipments of old tailings near Melrose. The Bureau estimates about 53 percent of the State's silver output was recovered from copper ore concentrates and nearly 24 percent from zinc-lead ore concentrates. The remainder was recovered mostly from crude smelting dry and siliceous ores.

Copper production increased slightly, output being 127,500 tons in 1941 compared to 126,391 tons in 1940. During the World War period, the State produced a yearly average of 145,102 tons of copper. Virtually all the output of copper was recovered from copper ore and mine-water precipitates from properties of Anaconda at Butte.

About 40 percent of the lead output in Montana was recovered from the zinc-lead ore deposits operated by the Anaconda. Other large producers were the Flathead mine, Jack Waite, the slag-fuming plant at East Helena, and the Mike Horse and Broadwater-Moulton properties. The drop in lead production was due chiefly to the closing of the Comet-Gray Eagle group of mines, in Jefferson County. Lead production totaled 21,750 tons in 1941, against 23,036 tons in the previous year.

Zinc production in 1941 was the highest since 1929, 55,900 tons being produced, against 52,587 tons in 1940. The highest output was 114,629 tons in 1916. Mines of the Anaconda Copper Mining Co. at Butte accounted for 65 percent of the zinc output.

Montana's output of ore and old tailings in 1941 totaled about 5,750,000 tons against 5,099,241 tons in 1940.

NEVADA—Increases in metal output, except for gold, was reported from mining operations in this State. This decline is attributed to the dips in production from the smaller operations, as the ten mines leading in gold production in 1940 increased their output in 1941. The leading producer was the Getchel Mine, Inc., followed by the Nevada Consolidated Copper Co. and Consolidated Coppermines Corp., which derive gold as a byproduct from copper ore. A gold dredge of the Manhattan Gold Dredging Co., Nye County, was the fourth largest producer. Total output of gold in 1941 was 372,300 oz., compared to 383,933 oz. in 1940.

Greater output of silver was chiefly due to a higher production of lead-zinc ores and copper ore containing silver as a byproduct. Production in 1941 totaled 5,786,000 oz., against 5,175,928 oz. in the previous year. The leading silver producer was Desert Silver, Inc., which treated ore from the Nivloc mine, in Esmeralda County. The second largest source of this metal was the Combined Metals Reduction Co., that recovered silver as a byproduct from lead-zinc ores.

Nevada Consolidated Copper Corp. continued to be the State's largest copper producer, followed by its neighbor the Consolidated Coppermines Corp., both operating in the Robinson district, White Pine County. The other important copper producer is the Mountain City Copper Co. in Elko County. Copper production in the State during 1941 was 78,810 tons, against 78,454 tons in the previous year. During 1942 additional copper is expected to be produced in the Battle Mountain district of Lander County by the International Smelting & Refining Co. from property leased from Copper Canyon Mining Co.

The Pioche district in Lincoln County remained the State's largest lead and zinc producer, accounting for 70 percent of the lead and 96 percent of the zinc output in 1941. The Combined Metals Reduction Co., the leading supplier, shipped zinc-lead ore to its flotation plant while it was engaged in building a 450 ton flotation mill at Pioche. The new plant was completed in September and thereafter most of the company's production was treated locally. Lead production for the State in 1941 totaled 9,490 tons, compared to 7,499 tons in 1940. Zinc output was 14,630 tons in 1941, against 11,833 tons in 1940.

NEW MEXICO — Production of copper, lead, and zinc increased during 1941 but output of gold and silver declined. The State's largest metal-mining operation, the Chino copper unit of the Nevada Consolidated Copper Corporation, accounted for the increase in total recovered copper in the State.

Gold production totaled 28,469 oz., against 35,943 oz. in 1940. The largest single producer of gold and silver in the State was the Black Hawk Consolidated Mines Co., near Mogollon. There were some gold placer operations in Colfax, Lincoln, and Sierra counties that contributed to the gold output during the year.

Copper produced in 1941 was 71,562 tons, compared to 69,848 tons in the previous year. Most of this output came from the Chino open-pit mine, in Grant County. The Phelps Dodge Corp. started leaching copper ore on the upper levels of its Burro Mountain property.

Greater zinc output from New Mexico may be in prospect from the diamond-drilling programs in the Central District maintained during the year. Zinc output was 37,845 tons, against 30,313 tons in 1940.

UTAH—The outstanding mining feature in this State occurring in 1941 was a new record in copper output, the highest in the State's history. Production of gold, silver, lead, and zinc, on the other hand, declined slightly during the last half of the year.

Gold produced in Utah in 1941 declined 2 percent from that of 1940, but the output of gold in the Bingham district, where the Utah Copper Co. produced copper at above capacity, increased 6 percent. The second largest gold-producing district is centered at Mercur. Gold production in 1941 was 347,784 oz., against 355,494 oz. in the previous year.

A decline of 8 percent in silver production occurred in 1941, output being 11,203,733 oz., against 12,172,299 oz. in 1940. The Bingham district's 1941 production remained virtually the same as in the previous year, but the Park City and Tintic regions showed a 3 and 11 percent decline respectively.

Operations by the Utah Copper Co. were maintained at one-third above rated capacity during 1941, resulting in the largest copper output in the history of the State. The company's huge open pit at Bingham (see photograph page 110) was operated on a seven-day schedule at the end of the year, with ore shipments averaging about 88,000 tons per day to its Magna and Arthur mills. Other copper producers in Utah having an output over 500 tons in 1941 were the Ohio Copper properties and the United States & Lark property, both in the Bingham district, and the Tintic Standard property, in the Tintic district. The total 1941 copper production in Utah reached 262,577 tons, against 231,864 tons in the previous year.

Lead recovered in Utah comes chiefly from zinc-lead ores mined in the State. The Bingham district remained the largest producer, but its output declined 4,285 tons compared with 1940's record. Decreases at the United States & Lark property and the National Tunnels Co. property accounted for the decline. The latter company ceased operations during the third quarter of 1941. The leading producers of lead accounting for about 84 percent of the State's total were the United States & Lark, Park Utah Consolidated Silver King Coalition, Tintic Standard, Calumet, Chief Consolidated, and New Park Mining Co.

The decline in zinc output was comparable to the drop in lead, as 4,158 tons less zinc were produced in 1941. The same properties reporting a drop in lead output also had declines in zinc production. Total zinc produced in 1941 was 39,987 tons, against 43,788 tons in 1949. The leading zinc mines were the United States and Lark, in the Bingham district; the Silver King Coalition and Park Utah Consolidated, in the Park City region; the Calumet

(*Continued on page* 74)

CANADA

Metals placed under strict control to insure adequate supplies for war. Dominion's gold output increases slightly

John B. DeMille
Consulting Geologist
Montreal, Quebec

WITH MINE OUTPUT advancing an estimated 4.6 percent in 1941 to a total value of $553,941,000, the highest on record, drastic changes in government policy took effect on all branches of Canada's mineral industry. Munitions have become the big business of the Dominion, and, in securing adequate supplies of nickel, copper, and zinc for war effort, along with gold that will maintain credit in the United States, the national economy has been turned over to two agencies that have absolute authority. These are the Department of Munitions and Supply, which is the supreme purchasing control, and the Wartime Prices and Trade Board, which sets prices and wages throughout the land. The Metals Controller, who is working under this closely integrated program, is the arbiter of mining.

Allocations of the most vital metals that are refined in Canada amounted to well over 1,000,000 tons in 1941. These are nickel, copper, zinc, lead, and aluminum, the latter from bauxite mined in British Guiana. The rate is, proportionately, about four times the United States rate of production. The world's greatest aluminum plant, which has been enlarged several times over, is located in Quebec.

Since 1939, wartime censorship has withheld production figures for base metals, which reached a combined value of $166,157,000 in 1941, against $155,922,881 the year before. The official estimate of gold output was lower than anticipated, at $204,906,000, compared with $204,479,083 in 1940. All metals had a combined value of $393,269,000 in 1941, up from $382,503,012 in 1940.

Figures for the first ten months of 1941 show silver at 16,940,012 oz., down from 19,293,224 oz., and feldspar slightly lower—17,233 tons, compared with 18,600 tons in 1940—but all other reported minerals made a substantial growth in the ten-month period. The following 1941 production is compared with the same period in 1940 (in brackets): cement 7,324,025 (6,627,710) bbl.; clay products, $5,485,715 ($4,414,475); coal, 14,535,316 (14,016,547) tons; gypsum, 1,316,790 (1,276,649) tons; lime, 701,054 (585,745) tons; salt, 241,097 (194,987) tons.

The level of industrial activity in Canada mounted steadily throughout 1941, chiefly to fill Government war orders. The index of the Canadian Bank of Commerce went from 134 in November 1940 to 165 in November 1941 (1937=100). The power input for the production of ferro-alloys is 600 percent higher than before the war, and both non-ferrous metal producers and the iron and steel trades are working at 50 percent greater capacity than a year ago. Non-metallic mineral products, at 90 percent of capacity in the previous year, moved up to 102 percent in November 1941. The wage payroll index for the mining industry advanced from 116 in October 1940 to 131 in October 1941. No major advance beyond this level is indicated for the immediate future. There are indications that gold mining is fairly well stabilized at mill capacities planned for 1942; nickel and some other metals may not attain maximum output until 1943.

Price ceilings that came into effect on Dec. 1 and the freezing of wages for the duration have tended to stabilize mine costs, although the Federal tax policy is not yet clearly defined. The importance of the move taken by the Wartime Prices and Trade Board is shown by the analysis made by the Dominion Bureau of Statistics. From August 1939 to the end of September 1941, while the general index of wholesale prices rose 28 percent, that of the industrial-materials group rose 40 percent. In the past two years there has been practically no change in the price received by Canadian mine operators for their products.

Tax increases absorbed by gold mines in the last two years have amounted up to 100 percent and have been met successfully by the great majority of the operators. Apprehension is growing, however, that Ottawa's next budget will bring stiffer increases. There is also the threat that any further increases in gold production may be blocked by priorities rulings that would withhold mining equipment. On the other hand, Canada is more than ever in need of strong credit in the United States for war purchases. This coun-

Table I—Cumulative Dividend Record of Canadian Metal Mines (*a*)

Province and District	1938	1939	1940	1941	Total to End of 1941
ONTARIO :					
Sudbury (*b*)	$32,091,513	$32,091,513	$31,340,556	$31,757,738	$356,986,295
Cobalt (*c*)	180,000	180,000	180,000	180,000	107,702,442
Porcupine	12,830,335	14,254,781	15,696,296	16,006,238	203,908,664
Kirkland Lake (*d*)	16,299,277	15,940,989	13,923,096	14,140,724	181,319,113
Patricia	3,095,650	3,628,503	4,977,457	4,636,545	21,636,505
Matachewan (*e*)	.....	31,682	100,282	63,364	195,329
Michipicoten	.....	.....	.....	64,200	64,200
BRITISH COLUMBIA (*b*)	$13,852,018	$13,227,279	$14,226,599	$14,079,085	$233,852,283
QUEBEC	11,234,819	13,901,065	15,617,831	16,064,893	98,469,991
MANITOBA	4,773,735	5,852,397	6,882,721	6,663,116	35,825,828
NOVA SCOTIA (*g*)	.....	.....	29,496	.....	77,424
YUKON (*h*)	.....	.....	365,235	528,489	893,724
N.W. TERRITORIES:					
Yellowknife (*i*)	.....	.....	.....	149,775	149,775
MISCELLANEOUS (*j*)	1,233,111	1,168,708	1,329,863	1,522,762	8,846,511
Totals	$95,620,458	$100,276,917	$104,669,432	$105,856,929	$1,249,928,084

(*a*) Revised to Dec. 3, 1941, based on data from *Northern Miner*. (*b*) Payments in U. S. funds made by International Nickel, Howe Sound, Granby Cons. (*c*) Since 1933 represents payments by Nipissing Mines, a holding company. (*d*) Includes three Larder Lake producers. (*e*) Young-Davidson Mines. (*f*) Cline Lake GoldMines. (*g*) Dividend record incomplete. (*h*) Yukon Cons. (*i*) Negus Mines. (*j*) Includes seven holding companies.

Table II—Canadian Metal Mines Producing in 1941

Mining Company	Gold Recovery per Ton 1941	Working Costs per Ton 1941 (*l*)	Daily Mill Tonnage 1941	Daily Mill Capacity 1942	Date of First Production
ONTARIO					
Aunor Mines (*h*)	$11.58	.....	450	475	Jan. 1940
Algoma Ore Properties (siderite)	.....	.....	.....	2,000	July 1939
Josephine Iron Mines (hematite)	.....	.....	.....	.....	Sept. 1942
Bankfield Cons. Gold Mines	6.39	$7.39	109	145	May 1937
Berens River Mines (*ii*)	16.39	.....	240	255	Sept. 1939
Bidgood Kirkland Gold Mines	13.74	8.64	115	160	July 1934
Bonetal Gold Mines	6.16	.....	100	110	Nov. 1941
Broulan Porcupine Mines	7.39	3.52	399	425	Nov. 1939
Buffalo Ankerite Gold Mines	6.26	5.09	1,228	1,300	June 1926
Central Patricia Gold Mines	13.75	10.78	400	410	June 1934
Chesterville Larder Lake Gold	5.63	3.06	700	1,200	July 1939
Cline Lake Gold Mines (O'Brien)	4.95	4.83	241	250	July 1938
Cochenor-Willans Gold Mines	11.56	5.97	174	200	Dec. 1939
Coniaurum Mines (*j*)	9.84	6.02	535	600	May 1928
Delnite Mines (Sylvanite)	7.59	4.58	470	500	June 1937
DeSantis Porcupine Mines	7.30	6.41	170	175	May 1939
Dome Mines	12.39	4.26	1,747	1,800	1910
Faymar Porcupine Mines	9.32	.....	131	250	Mar. 1940
Goldwood Gold Mines	18.64	.....	35	65	June 1941
Golden Gate Mining Co.	9.16	8.68	70	150	May 1938
Hallnor Mines (*h*)	16.81	5.11	377	400	June 1938
Hasaga Gold Mines	7.86	7.16	166	350	Sept. 1936
Hollinger Cons. Gold Mines	9.46	5.10	5,100	5,200	1910
Howey Gold Mines (*k*)	2.50	1.34	1,271	1,500	Apr. 1930
Hoyle Gold Mines	4.74	3.78	500	750	Feb. 1940
Jason Gold Mines (Argosy)	16.35	9.59	135	150	June 1941
Jerome Gold Mines	7.28	3.75	.....	500	Aug. 1948
Kerr Addison Gold Mines	8.79	4.00	2,112	2,200	May 1939
Kirkland Lake Gold Mines	14.94	7.29	423	450	1918
Lake Shore Mines	15.44	7.13	1,563	2,500	1917
Leitch Gold Mines	29.18	13.86	84	115	Jan. 1934
Little Long Lac Gold Mines	13.62	7.87	330	350	Dec. 1931
Lower Seine Gold Mines	.....	.....	.....	45	Aug. 1940
Macassa Mines (*c*)	18.25	9.82	434	450	Oct. 1935
MacLeod-Cockshutt Gold Mines	9.52	5.63	670	1,000	Apr. 1938
Madsen Red Lake Gold Mines	8.84	3.61	407	410	Aug. 1938
Magnet Cons. Gold Mines (*i*)	20.74	.....	130	160	July 1939
Matachewan Cons. Mines (*j*)	4.46	3.83	525	1,000	Nov. 1934
McKenzie Red Lake Gold Mines	11.95	5.95	240	250	Mar. 1935
McIntyre Porcupine Mines	10.91	5.22	2,339	2,550	1912
McMarmac Red Lake Gold Mines	16.09	.....	88	90	Oct. 1940
Moneta Porcupine Mines	19.85	6.73	172	200	Jan. 1938
Hard Rock Gold Mines	8.36	6.00	400	410	Jan. 1937
Naybob Gold Mines (Hayden)	10.41	5.64	200	225	1939
Omega Gold Mines	5.23	4.23	444	525	1936
Pamour Gold Mines (*h*)	4.68	3.22	1,553	1,700	May 1936
Paymaster Cons. Mines	8.33	6.27	598	600	Oct. 1934
Pickle Crow Gold Mines	17.84	11.45	422	450	Apr. 1935
Preston East Dome Gold Mines	12.25	6.64	598	1,000	Mar. 1939
Ross Mine (Hollinger)	9.80	6.02	262	300	Jan. 1936
Sachigo River Exploration Co.	29.47	.....	48	50	May 1938
Sand River Gold Mining Co.	10.81	9.76	89	110	Dec. 1937
St. Anthony Gold Mines	3.97	3.50	200	200	Aug. 1927
Sturgeon River Gold Mines	17.84	11.37	71	85	Apr. 1937
Sylvanite Gold Mines	13.03	5.81	583	600	July 1927
Teck-Hughes Gold Mines	10.68	5.64	600	1,300	1917
Toburn Gold Mines (*i, c*)	19.44	15.48	174	180	1913
Tombill Gold Mines (*ii*)	11.00	.....	125	130	Feb. 1938
Tyranite Mines (Sylvanite)	6.12	4.92	198	200	June 1939
Uchi Gold Mines	7.13	4.62	640	750	May 1939
Upper Canada Gold Mines	15,40	.....	200	250	Nov. 1938
Upper Seine Gold Mines	4.86	.....	10	100	Nov. 1940
Wendigo Gold Mines	14.11	8.04	101	110	Jan. 1936
Wright-Hargreaves Mines (*c*)	19.66	10.23	1,213	1,250	1912
Yama Gold Mines	20.00	.....	56	125	Oct. 1941
Young-Davidson Mines (*z*)	3.88	2.62	989	1,100	Sept. 1934
International Nickel Co. (*pp*)	.....	.....	25,000	33,000	1916
Falconbridge Nickel Mines (*j*)	.....	.....	1,800	3,000	Feb. 1930
Lake Geneva Mining Co. (*p*)	.....	.....	.....	100	Aug. 1941
QUEBEC					
Aldermac Copper Corp. (*d, qq*)	.....	.....	856	1,200	Jan. 1937
Arntfield Gold Mines (*c*)	$3.33	$3.39	225	400	Aug. 1935
Beattie (Quebec) Gold Mines (*j*)	4.23	2.28	1,862	1,900	May 1935
Belleterre Mines (McIntyre)	13.52	6.64	352	375	Aug. 1936
Canadian Malartic Gold Mines (*j*)	3.98	3.18	779	1,000	May 1935
Central Cadillac Mines (*zz*)	7.02	.....	276	300	Nov. 1939
Chromite Limited	.....	.....	.....	50	Dec. 1941
Cournor Mining Co.	6.50	4.00	215	225	Sept. 1937
East Malartic Mines (*c*)	5.38	4.75	1,489	1,800	Nov. 1938
Francoeur Gold Mines	6.98	3.70	207	400	July 1938
Golden Manitou Mines (*u*)	.....	.....	.....	600	July 1942
Lamaque Mining Co. (T.-Hughes)	11.57	6.45	1,260	1,300	Apr. 1935
Lapa Cadillac Gold Mines	6.00	4.69	200	300	July 1938
Noranda Mines (*ww*)	.....	.....	6,130	7,000	Dec. 1937
Normetal Mining Corp. (*e, jj, yy*)	.....	.....	625	775	Sept. 1937
Malartic Gold Fields	8.25	3.36	650	1,000	Dec. 1939
Mic Mac Mines (*i*)	.....	.....	.....	500	Mar. 1942
McWatters Gold Mines	7.44	6.26	117	150	Sept. 1934
O'Brien Gold Mines	14.07	7.07	191	220	Sept. 1934
Pandora Cadillac Gold Mines	5.32	.....	173	200	Sept. 1940
Perron Gold Mines	13.07	7.05	412	425	Apr. 1934
Powell Rouyn Gold Mines (*n*)	4.48	3.45	970	1,000	1937
Quyon Molybdenite Co.	.....	.....	100	150	Oct. 1941
Senator-Rouyn	7.47	3.76	269	300	Oct. 1940
Sigma Mines (Dome)	7.71	4.69	1,058	1,100	Mar. 1937
Siscoe Gold Mines	6.81	4.71	670	1,000	Jan. 1929
Sladen-Malartic Mines	3.26	2.56	717	750	Jan. 1938
Stadacona Rouyn Mines (*v*)	5.10	4.18	450	500	Nov. 1936

try is keeping out of New York for Federal financing and, so far, is not one of the nations to be included in the Lease-Lend schedules. As a cash customer, the Dominion leans heavily on shipments of bullion as her prime commodity for export. As further evidence of Canada's heavy credit requirements was the reported gift to Winston Churchill during his Ottawa visit of a billion dollars, which cancels indebtedness of about two-thirds of Britain's purchases in the Dominion since the outbreak of war.

Just as top priorities ratings for new equipment are held by Noranda, International Nickel, and other base-metal producers, preference would also be given these operators for mine labor. No serious labor shortages had developed up to the end of the year. The straight gold producers employ an estimated 30,000 men and the time may not be far off before these workers will be in greater demand where they will more directly affect the war effort.

All parts of Canada increased gold output 1.2 percent in the first ten months of 1941, as compared with a 6.5 percent advance in Quebec. This province in 1940 passed the 1,000,000-oz. mark in gold production for the first time, marking an advance of 6.7 percent above the previous year. All other mineral products reached the highest figures ever recorded by the Quebec Bureau of Mines since official monthly statistics were started in 1931. Substantial increases in copper, zinc, and pyrite concentrates were indicated by enlarged capacities at Waite Amulet, Normetal, and Noranda, and construction has been started on a 600-ton zinc concentrator on the Manitou property east of Val d'Or.

Mining operations have been resumed at the old Calumet Island zinc property, near Ottawa, where ore reserves are estimated at 1,300,000 tons. Pyrite and sintered iron ore are to be shipped by Delandore Iron & Sulphur Mines. A manganese deposit is being developed on the Magdalen Islands, in the Gulf of St. Lawrence. Molybdenite and chrome are again being produced on a small scale at properties that have been idle since the last war. A concentrator has been built on the Gatineau River by the Aluminum Company for the production of magnesium from brucite. Mica, feldspar, and apatite have been produced in record-making quantity, which is also true of asbestos. Underground mining methods have been successfully adopted by the Asbestos Corporation and the Johnson's Company, although open pits continue to be used in the Thetford district for removing the great bulk of ore.

Several Quebec gold mines increased mill capacity in 1941 and two new mills were under construction at the end of the year with a combined potential output of 700 tons a day. The Vicour mine, farther east than any of the gold producers, is considering a 500-ton mill this year. The Duquesne is having encouragement from underground exploration in the Beattie district and may be ready for a mill decision in 1942. Promising gold discoveries have been reported in Barraute Township, 25 miles northeast of Val d'Or, where Teck-Hughes and Hollinger are taking the initiative in opening up a promising new camp. Important ore developments at the Vicour, Malartic Gold Fields, and Belleterre mines led to prospecting activity in those areas and attracted more public interest than for several seasons. The Federal Department of Mines and Resources reported that reconnaissance work by geological parties last summer had disclosed two large areas in the unexplored northern part of the Province that merited prospecting for gold and other metals.

Ontario maintained gold output about on the level of 1940. The Province has 64 operating gold mines, three of them added in the past year with a combined capacity of 1,300 tons. A tonnage increase for all of Canada of about 10 percent has been largely offset by the lower grade of ore treated.

Table II—Canadian Metal Mines Producing in 1941

Mining Company	Gold Recovery per Ton 1941	Working Costs per Ton 1941 (l)	Daily Mill Tonnage 1941	Daily Mill Capacity 1942	Date of First Production
Sullivan Cons. Mines	10.90	6.50	347	500	May 1934
Waite Amulet Mines (*h, vv, f*)	.....	.....	1,190	1,500	June 1937
Wood Cadillac Mines	7.10	.....	175	225	Dec. 1939
Delandore Iron & Sulphur Mines	.....	.....	.....	500	Oct. 1942
West Malartic Mines	.....	.....	.....	200	May 1942
NOVA SCOTIA					
Avon Gold Mines (Oldham)	$6.82	.....	49	100	May 1936
Caribou Gold Mines (Ross, *r*)	.....	.....	.....	40	1934
Guysboro Mines (*j*)	5.30	$5.57	66	100	1934
Lacey (Government project)	.....	.....	.....	25	1934
Lake Catcha Tailings Co.	.....	.....	.....	20	1940
Orleans Mines	.....	.....	.....	20	1940
Queens Mines	.....	.....	.....	20	1935
Seal Harbor Gold Mines	1.97	2.50	258	260	Aug. 1936
Victoria Gold Mines	.....	.....	.....	25	1941
Wine Harbour Gold Mines	.....	.....	.....	100	May 1937
MANITOBA					
God's Lake Gold Mines	$12.96	$6.56	196	200	Sept. 1935
Golden West Mines	.....	.....	.....	125	1941
Gunnar Gold Mines (*c*)	11.79	9.42	141	150	Aug. 1936
San Antonio Gold Mines	11.42	5.26	340	550	July 1932
Hudson Bay Mining & Sm. (*dd*)	.....	.....	5,500	6,000	Sept. 1930
Sherritt Gordon Mines (*j, f*)	.....	.....	2,011	2,100	Aug. 1937
SASKATCHEWAN					
Box Mine (*r*)	.....	$1.81	1,300	1,500	July 1939
Pamon Gold Mines	.....	.....	.....	25	1941
NORTHWEST TERRITORIES					
Con Mine (*r*)	$28.70	.....	180	380	Sept. 1938
Eldorado Gold Mines (*g, o*)	.....	.....	.....	100	1933
Giant Yellowknife Gold M.	.....	.....	.....	25	1942
Negus Mines	32.82	$18.81	62	80	Feb. 1939
Ptarmigan Mines (*r*)	.....	.....	.....	100	Dec. 1941
Slave Lake Gold Mines	.....	.....	.....	50	Oct. 1941
Ruth Mines (*r*)	.....	.....	.....	100	1942
Thompson-Lundmark Gold M. (*r*)	31.50	13.64	89	100	Aug. 1941
BRITISH COLUMBIA					
Alpine Gold Mines	.....	.....	.....	50	1941
Bayonne Cons. Mines	$16.40	$12.27	60	65	Apr. 1940
Bralorne Mines (*q*)	20.37	10.17	530	550	Feb. 1932
Brooklyn Stemwinder Gold M.	.....	.....	.....	60	1939
Buccaneer Mines	.....	.....	.....	25	1941
Buena Vista Mining Co. (*r*)	2.60	2.26	675	750	Apr. 1938
Cariboo Gold Quartz Mining	14.08	8.34	370	400	Jan. 1933
Central Zeballos Gold Mines	.....	.....	.....	50	Jan. 1940
Gold Belt Mining Co.	10.91	4.50	155	165	Oct. 1938
Gold-Silver-Tungsten M. & M.	.....	.....	.....	100	1941
Greenwood Ore Concentrating	.....	.....	.....	50	1936
Hedley Mascot Gold Mines (*a, c, t*)	12.86	9.46	198	250	May 1936
Highland Surprise Mining Co.	.....	.....	.....	75	1940
Homeward Mines	.....	.....	.....	50	1941
Island Mountain Mines (*ii*)	17.44	9.14	152	160	Nov. 1934
Kelowna Exploration Co. (*s*)	.....	.....	.....	275	1934
Kootenay Belle Gold Mines (*b, u*)	12.69	10.98	100	120	Dec. 1934
Mt. Zeballos Gold Mines	17.85	10.19	60	65	Aug. 1939
Musketeer Mines	.....	.....	.....	25	1942
Pioneer Gold Mines of B. C.	20.14	7.56	214	400	1928
Polaris-Taku Mining Co.	12.00	.....	.....	300	1938
Privateer Mines	31.76	8.97	90	100	Oct. 1938
Reno Gold Mines	14.50	10.46	120	140	Aug. 1929
Sheep Creek Gold M. (*a, c*)	18.66	10.53	152	160	May 1935
Silbak-Premier Mines (*i, m*)	10.25	5.81	.....	600	1919
Spud Valley Gold Mines	12.43	.....	107	110	Nov. 1938
Surf Inlet Cons. Gold M.	14.48	.....	78	150	Apr. 1936
Ymir Yankee Girl Gold (*u*)	7.54	5.18	140	150	July 1934
Base Metals Mining Corp. (*e, p*)	.....	.....	.....	300	Nov. 1937
Britannia Min. & Smelt. Co. (*a, p, w*)	.....	.....	.....	6,500	1903
Columbia Tungstens	.....	.....	.....	50	1939
Cons. Min. & Smelt. Co. of Canada (Kimberley) (*p*)	.....	.....	.....	6,600	1906
(Tadanac) (*a, y*)	.....	.....	.....	2,400	1906
Granby Cons. Min. & Smelt. (*a, oo*)	.....	.....	.....	5,000	June 1937
Mining Corp. of Canada (Monarch) (*p*)	.....	.....	.....	280	Jan. 1940
Pinchi Lake Mercury Mines (*r*)	.....	.....	.....	800	1940

(*a*) Copper-gold producer. (*b*) Former producer. (*c*) Costs include all charges. (*d*) Shipping copper and sulphur concentrates. (*e*) Controlled by Mining Corp. of Canada. (*f*) Average ore grade 1939; 5.23% Cu; 0.71% Zn; 0.323 oz. Ag; 0.0321 oz. Au. (*g*) Production temporarily suspended. (*h*) Controlled by Noranda Mines. (*i*) Controlled by Premier Gold Mining Co., one of the 10 principal foreign development companies of American Smelting & Refining Co. (*j*) Controlled by Ventures Limited; 45% in Beattie Gold. (*k*) Ore exhausted and mine shut down in Nov. 1941. (*l*) Before taxes, depreciation and depletion. (*m*) Controlling five mines in Portland Canal area, including the Premier, largest silver producer in Canada. (*n*) Shipping flux-gold ore to Noranda smelter in addition to mill feed for cyanidation on property. (*o*) Approximate monthly output 1939; 3 grams radium; 80,000 oz. silver; mine shut down in 1940 due to large stocks at Port Hope refinery. (*p*) Silver-lead-zinc producer. (*q*) Also treating ore from Bradian mine. (*r*) Controlled by Cons. Min. & Smelt. Co. of Canada. (*s*) Formerly largest B. C. gold producer. (*t*) Silver producer. (*u*) Gold-silver-lead-zinc producer. (*v*) Operating in bankruptcy under custodian. (*w*) Controlled by Howe Sound Co. (*x*) Controlled by Nipissing Mines. (*y*) At Trail are located custom concentrator, zinc production plant and refinery, copper smelter and refinery, fertilizer plant, etc. (*z*) Controlled by Hollinger Cons. Gold Mines. (*dd*) Ore grade 1939; 2.01% Cu; 4.14% Zn; 0.106 oz. Au; 1.59 oz. Ag. Smelter byproducts were cadmium, selenium, tellurium. (*ii*) Controlled by Newmont Mining Co. (*jj*) Production 1939; 6,000,000 lb. Cu; 18,000,000 lb. Zn; 2,400 oz. Au; 300,000 oz. Ag; copper concentrates treated at Noranda. (*oo*) Production 1939; 33,500,000 lbs. Cu. (*pp*) Production 1939 from Frood, Creighton, Levack and Carson Mines; 210,194,135 lb. Ni; 324,850,921 lb. Cu; 2,448,386 oz. Ag; 78,751 oz. Au; 240,778 oz. platinum metals; 99,686 lb. selenium; 3.288 lb. tellurium. (*qq*) Average ore grade 1939; 1.97% Cu; 0.011 oz. Au; 0.435 oz. Ag; 50% sulphur concentrates. (*vv*) Copper-zinc-gold producer. (*ww*) Production 1939; 83,257,148 lb. Cu; 266,532 oz. Au; 595,102 oz. Ag; in Montreal a subsidiary refines blister copper from the Noranda and Flin Flon smelters. (*xx*) Operating the Thompson Cadillac mill. (*yy*) Average ore grade 1939; 2.57% Cu; 8.307% Zn; 0.03 oz. Au; 2.946 oz. Ag.

Ontario operators have a combined daily tonnage of 37,605, compared with 59,925 for the 144 gold mines operating throughout the country. Only two new mills are planned for 1942, both in northwestern Ontario, with a combined capacity of 225 tons; and expansion of present mills has been projected at four mines. Lake Shore and Teck-Hughes plan to continue curtailed operations after the Kirkland Lake strike has been settled, and the Howey, Morris Kirkland, and four smaller operators have suspended mining and sold their equipment.

Prospecting activity in Ontario led to gold discoveries in the Sturgeon Lake and Savant Lake areas, the Rundle area, 15 miles south of Porcupine, and in the sections both east and west of Larder Lake. Exploratory work with both diamond drilling and underground attack was particularly directed to the Sudbury and Lake Superior districts, for nickel and iron. About 400,000 tons of sinter ore from the new Helen mine was shipped through Michipicoten Harbor to Algoma Steel and United States steel mills. Plans have been made to bring the old Josephine mine, 10 miles north of the Helen, into production for its siliceous hematite. A somewhat similar ore occurs in extensive deposits at Steep Rock Lake, where production problems are now under study.

International Nickel Company of Canada, one of the world's major enterprises, is delivering more than 90 percent of its products to fill high-priority war orders and plans to increase United States deliveries by 20 percent before the end of 1942. The old Murray and Stobie mines are being brought into production and a $35,000,000 expansion program is to step up nickel output another 50,000,000 lb. a year. In 1941 the United States took more than two-thirds of the total world nickel supply, about 70 percent of it going to steel mills. Important work continues to be carried on by the seven research laboratories that are located in the United Kingdom, Canada, and the United States. The last year of complete world statistics, 1938, shows total output of 110,500 metric tons, of which 95,514 tons came from Canada. International Nickel was then treating an average of 15,000 tons of ore daily, compared with 25,000 tons last year and an estimated 33,000 tons a day in 1942.

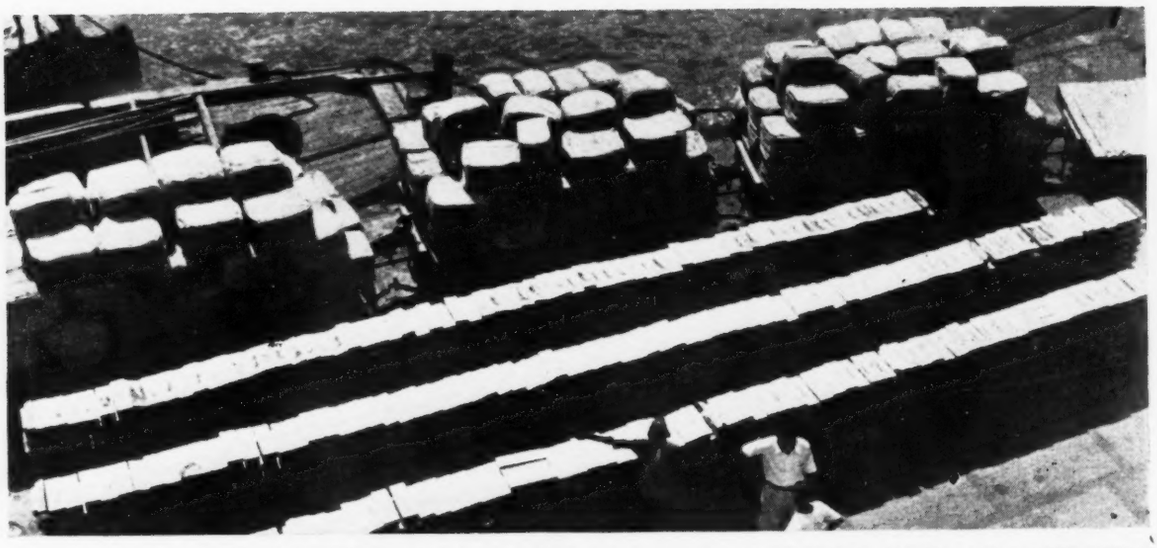
The only cobalt refinery in the British Empire is at Deloro, treating the smaltite and erythrite ores of the Cobalt area. Several of the abandoned silver mines are being worked on a small scale under lease, supplying British requirements and a large part of those of the United States. Encouraging results have come from tests on nepheline syenite in southern Ontario as a source of alumina. Minor amounts of tungsten are being recovered from the scheelite associated with gold-bearing quartz veins at Hollinger and other Porcupine mines. A process for the recovery of high-grade magnesia from the brucite occurrences in crystalline limestones in southern Ontario and Quebec was developed by an officer of the Bureau of Mines. Development of this mineral on a commercial scale has been started and is expected to make Canada independent of foreign sources in producing magnesium refractories.

British Columbia, ranking third in mining among the provinces, has shown important progress in the past year. The output in 1940 was valued at $75,352,730, an all-time record that was probably passed by a wide margin in 1941. Through the enterprise of the

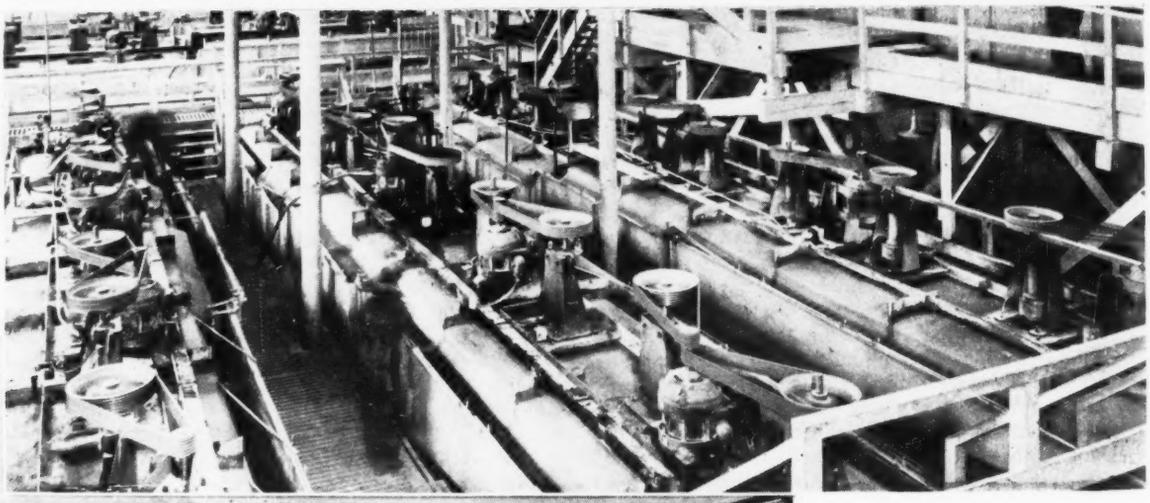
(*Continued on page* 72)

Troops guard locks so that record movement of iron ore down the Great Lakes may be uninterrupted. (For credit for this and other photos see contents page)

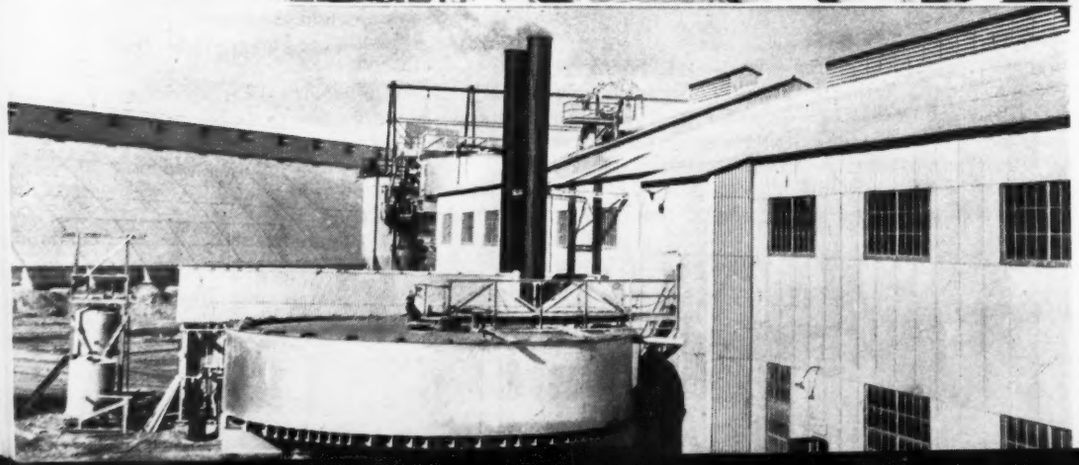
AN EVENTFUL YEAR FOR THE INDUSTRY



As war broke out in the Far East, shipments of tin and rubber piled on docks in Malaya were halted



Manganese carbonate is floated from Butte rhodochrosite ores in Anaconda's new plant, here seen in Montana

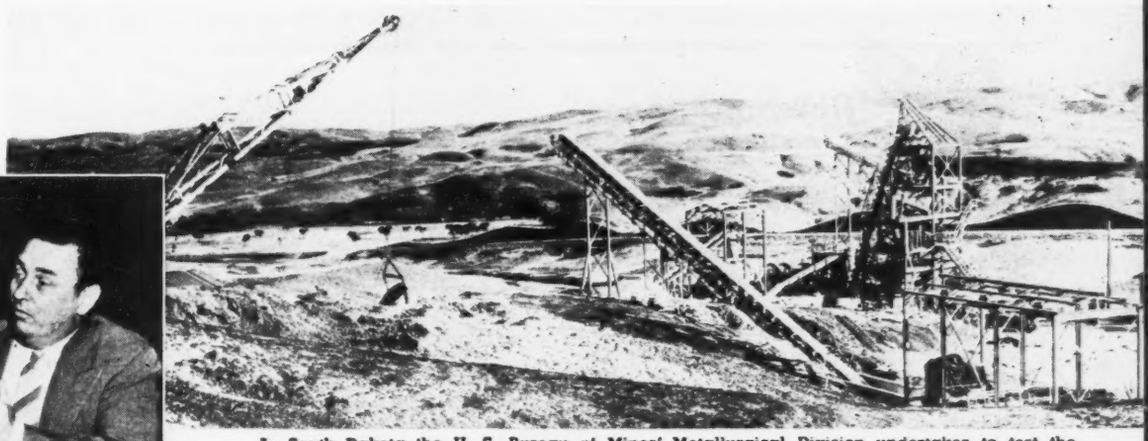


Waste magnesium chloride from the new refinery of Union Potash & Chemical Corp. in New Mexico is to be used as raw material for making magnesium in another plant to be built in the Southwest

N. V. Billiton company pours foundations for new smelter on Texas border to make tin from Latin-American ores

United States Vanadium Corporation completes this new mill in Montana to treat local chromite ore

Col. Philip B. Fleming, as administrator, confirms the "collar-to-collar" ruling



In South Dakota the U. S. Bureau of Mines' Metallurgical Division undertakes to test the area's low-grade manganese ores with this new pilot plant

Outstanding personalities. Left, Donald M. Nelson, now managing the War Production Board, and Leon Henderson, who is price administrator

Manganese pilot plants (right) at U. S. Bureau of Mines' Experimental Station, situated in Nevada, test Southwestern low-grade ores

Trenches exploring for tungsten are cut by U. S. Bureau of Mines on this property in White Pine County, Nev.

A. S. & R.'s zinc plant, located in northern Mexico, was the victim of a protracted strike, settled early in the year

Labor troubles in Kirkland Lake camp, Ontario, are successfully dealt with. Pickets in front of the Lake Shore offices

SOUTH AMERICA

Demand for metals proves great stimulus to the mining industry throughout the southern continent. Program of United States is an important factor

Newton B. Knox
Caracas, Venezuela

AS ELSEWHERE, the dominating factor affecting the mining industry in South America in 1941 was the war and particularly the rôle played in it by the United States. Every phase of mining has been influenced. Markets for mineral products have been somewhat restricted or, more commonly, indefinitely widened. Tin, tungsten, copper, antimony, beryl, mercury, mica, chrome, and nickel have found ready markets, stimulated during August, September, and October by Japanese purchases, often at a 50 percent mark-up over the prices being paid by the Metals Reserve buyers. On the other hand, certain non-metallics have suffered from the loss of European markets, and, particularly on the West Coast of South America, concentrates of non-strategic minerals have accumulated in warehouses for lack of shipping priorities.

As yet, serious shortages of machinery for mines already operating have not greatly hampered production, thanks to favorable priorities granted in the United States and Great Britain. It is probable, however, that many new enterprises have failed in their initial promise because of the difficulties inherent in securing, exporting, transporting, and importing equipment, and the impossibility in some instances of obtaining the foreign exchange necessary for the purchase. Not only has the war drastically restricted ocean transportation, but the difficulty of importing fuel has sometimes—especially in Brazil—had serious effects on the internal transportation systems and local power plants. The Brazilian railroads are built to handle normal traffic but limit the emergency output of iron and manganese ores. These ores in Minas Gerais come from the same districts, often the same mines.

Most enterprises are suffering from a scarcity of European and American technical personnel. In addition, the war has upset the internal economies of the producing nations, and the result has been increased government control over imports, exports, and exchange. Peru is now the only country in the continent with a free currency exchange. In general the miner receives preference and secures exchange reserved for productive industries, but often the exchange control affects him in unexpected ways. For instance, dollars in Argentina are now sold at free auction, and may reach a high figure that cannot be foretold in advance. In Colombia the miner is allowed 40 percent of his net product in foreign currency, *if it is available.* Venezuela has various rates of exchange, the net effect of which is that the miner receives one rate for his product and pays his domestic expenses in an economy pegged at a rate 25 percent higher.

The import and export permits required in all South American countries necessitate a special clerical staff for even the smallest undertaking. Chile is considering a new export tax on copper. In all South American countries the war has aided in causing marked increases in the cost of living, with the result that labor costs have risen and promise to continue rising at an increased rate. Taxes are also rising, and the exposed position of mining as a solvent, easily taxed industry of a semi-public nature promises continued tax increases.

No great discoveries were made in 1941, although the continued interest in exploration did bring to light a few new deposits. In general, two areas hold the greatest promise. The resources of the Brazilian Shield are well known in the states of Minas Gerais and São Paulo, but explorations of much of the rest of this great area of ancient rocks have been sporadic. Recent new activities in chromite, nickel, and magnesite indicate that many deposits still remain hidden. The Brazilian Government's geological service is making a systematic survey of the enormous country, but it will take many decades to assemble satisfactory data on its resources. The second great area of promise is the eastern slope of the Andes from Colombia to Patagonia. Thus far this area is notable for small hard-rock gold mines and placers, but most of it is little known or completely unexplored.

BRAZIL—The conditions of mining and the promise for the industry differ remarkably in each country. The accelerated activity in base-metal mining is well exemplified in Brazil, which, occupying half the area of South America, is proportionately important. The enormous beds of hematite-quartzite that outcrop in many places in Minas Gerais are Brazil's most spectacular mining resource. The country's ambition to supply steel for all South America has lately been stimulated by difficulties of importation and made feasible by a loan from the United States Government. Some of this ore is being mined now for local furnaces and a little is exported to the United States and Great Britain. The most notable deposit is that of Caué, near the town of Itabira. It is a hill which consists of a moderately dipping bed, 500 ft. thick, of hematite-quartzite containing great lenses of massive hematite running about 65 percent iron. Production is now some 400 tons a day of *rolamento,* which is limonite cemented hematite talus found at the base of the hill. Present plants call for the construction of 37 km. of railroad and a productive capacity of 2,000,000 or 3,000,000 tons yearly. The Casa de Pedra mine, in the same State, is producing a hematite with 68 percent iron, but suffers from difficulty in getting enough railroad cars. Ore is blasted down from five benches a total of 400 ft. high and 1,500 ft. wide. It is then transported to the railroad by aërial tram. A part of the deposit is manganiferous and the ore contains 34 percent manganese and 32 percent iron. The future capacity of this mine is calculated to be 60,000 tons per month.

The most important producer of manganese, however, continues to be Morro da Mina, near the town of Lafayette. This is a 500-ft. hill a large part of which consists of bodies of manganese oxides. About 4,000,000 tons has been taken out and production is now 20,000 tons per month of ore which runs 40 percent or more manganese. The ore is mined in open cuts and washed in trommels. The fines, which are stored, contain 34 percent manganese. Innumerable small properties in Minas Gerais have been recently opened and produce a few

tons daily. Near Ouro Preto a furnace originally intended for non-metallics was redesigned and now produces electrically a ferromanganese derived directly from manganiferous hematite ores. Great savings are said to be effected in transportation. Outside of Minas Gerais importance has been attached to various deposits, of which the most interesting is that of Urucúm, 12 miles from Corumbá in Matto Grosso. This deposit, which consists principally of two 10-ft. manganiferous beds interstratified with sandstones, is now being studied by the U. S. Geological Survey.

Prohibition of employment of foreign capital in Brazilian mining obliges governmental agencies to take an active part in developing the industry. The Department of Mines often undertakes to open promising properties and, after proving them, turns them over to private operators. Thus the Juca Viera mine, near Caété, Minas Gerais, has just been turned over to private hands, and now treats 100 tons a day of ore containing 4 to 5 grams of gold. The Pitanguí mine, near Caraçé Mountain, Minas Gerais, is just being opened by the Department, and ore is still being sought.

At Dom Bosco, in Minas Gerais, cinnabar mineralization was discovered in a bed of manganiferous hematite quartzite. The promise is poor, however, though the occurrence in such ancient shield area rocks is unusual.

Chromite in serpentines is worked in the State of Bahia. Similar serpentines at São Jose do Tocantins, State of Goias, contain veins of garnierite, which is treated in an electrical furnace for the production of nickel. A small wolframite deposit is being explored by the government of the State of São Paulo at Jandiahy. Another department of the same government recently opened a lead smelter at Apiai to treat the lead ores of the southern part of the State. Potential production is about 10 tons daily. At present, however, the mines do not produce enough to keep the smelter operating full time. The mining of mica and quartz in weathered pegmatites continues to employ primitive hand methods, being thus very sensitive to price, but production is rising, although much of the mica unfortunately still is being sent to India for splitting. Diamond production has also increased slightly, with the Metals Reserve buying steadily.

Lack of capital and poor transportation facilites are the principal obstacles in the way of a prosperous development of the mining industry in Brazil.

ARGENTINA—Lead, zinc, silver, tin, tungsten, beryl, and mica have shown great activity in Argentina. The St. Joseph Lead Co. is proceeding successfully with its Aguilar mine operations. This and some other small mines supply concentrates for the Puerto Vilelas smelter. Difficulty is often encountered in disposing of zinc concentrates, although in July the Metals Reserve purchased the greater part of these on hand.

The hills that form the pre-cordillera of the Andes contain a series of pegmatite dikes which are occasionally enriched in wolframite. Near them are sometimes to be found calcareous schists cut by scheelite veins. In the neighborhood of Villa Dolores activity has recently been taking place in opening new tungsten prospects and reopening old mines. In one place a 7-ft. thick pegmatite dike contains enough beryl to form an orebody, which has been opened by the Hochschild interests. Some of these dikes are worked for their mica, but nearly always as small enterprises. Pirquitas, in Jujuy, is producing increasing quantities of tin, draglining gravel that runs 4.3 kg. per ton, and continuing development on its tin-silver veins.

Early in 1941 La Escondida asphaltite mine, in Neuquen, closed down for lack of market in England.

In general, however, Argentina, which has so long neglected its mining industry in favor of agricultural activities, shows promise for the future which will be fulfilled as communications are opened up in the mountain region.

CHILE—The great mines of El Teniente, Potrerillos, and Chuquicamata are strained to capacity to fill the urgent war demand and get as much copper as possible out of the country before the proposed export tax is levied. Engineers have been careful to speed up production and at the same time avoid certain errors made during the last war, when the frenzied stripping of ore often resulted in ground instability which hampered subsequent operations. El Teniente has installed selective flotation to recover the molybdenite in the ore. It produces 2 to $2\frac{1}{2}$ tons of 95 percent MoS_2 concentrate daily. Its production of copper is 400 tons a day. To this the company adds 200 tons from the stock-pile, to export 600 tons.

The Punitaqui mine, in central Chile, has installed selective flotation to separate an auriferous copper concentrate from a mercury concentrate which is retorted on the property. The ore averages 5 grams of gold, 0.3 percent mercury and 0.25 percent copper per ton. The mill treats 400 tons daily. Gold and mercury oreshoots, though in the same vein, do not coincide.

The province of Coquimbo contains promising manganese deposits, of which Corral Quemado is the best known. There is no overburden and ore samples run 35 percent manganese, 35 percent calcite, and less than 3 percent silica. Bethlehem Steel Co. continues to operate the El Tofo iron deposits. The nitrate industry remains somewhat stagnant.

BOLIVIA—This is the only country in South America which depends economically almost entirely on mining. It is now suffering a mild boom superimposed on the depression brought on by the Chaco war and the unsettled conditions that followed it. Tin is in active production, though no great new mine has been opened. The operating companies are conservative about investing large sums in opening a great property which would have to be closed at the end of the war. However, they are actively engaged in setting small prospects on their feet. Contracts for tungsten with the Metals Reserve have frozen the price for three years, so that the greater part of new activity has been in this metal and in antimony.

Bolivia is now meeting about half the normal United States demand for tin. Most of it comes from mines which have produced only tin, such as Llallagua (which alone produces one-quarter of Bolivia's tin); some of it from mines like Potosí and Colquiri,

Here a road is being built from the Orinoco River 80 km. to the property of Iron Mines of Venezuela

MEXICO

New agreements made with Washington provide market for surplus metals. Strikes continue to mar labor situation

A. H. Hubbell

Associate Editor

WHATEVER the hopes that Mexico's mining industry may have had that the change made in that country's Administration late in 1940 would bring real betterment in the labor situation in 1941, they failed decidedly of fulfillment. Strikes, and discussions that fell short of strikes, studded the calendar throughout the year. Of these the most serious one, affecting an important reduction plant and a vital coal-and-coke producing center, was settled only after more than four months' duration, when the shortage of coke for metallurgical use had become serious. The present Administration is still credited with good intentions toward the industry and with possibly some effective work in its behalf, but is said to lack the authority necessary to deal with a labor movement that remains strong after its years of militant advance with Government backing.

Nevertheless the year was signalized by two stimulating events: first, the arrangement, announced July 14 by the Federal Loan Administrator at Washington, whereby this Government was to take over Mexico's exportable surplus of strategic materials, including antimony, copper, graphite, quicksilver, tungsten, tin, lead, and zinc; second, the agreement between Washington and Mexico City, signed Nov. 19, under which the U. S. Treasury would purchase monthly from the Mexican government 6,000,000 oz. of newly-mined silver at 35c. Thus during the year it came about, thanks to the good-neighbor policy and Uncle Sam's need for metals, that Mexico secured a single big customer for its surplus of these commodities, thereby greatly easing the situation for the industry. Under the accord of Nov. 19, moreover, a step was taken toward straightening out the situation arising from the expropriation of foreign-owned petroleum properties in March,

South America

which were originally opened as rich silver enterprises and are now worked out as far as the latter metal is concerned, and a small portion comes from placers such as the dredge at Huanuni. Ore washing in general, however, is hampered by the fact that the Bolivian *altiplano* is a very arid desert. Tin mineralization can be complex. Some mines are producing concentrates of which some of the principal minerals are unidentified, and in many of these operations tailing losses are found to run high.

Tungsten mining is typified by small mines working deposits of two classes —coarse-grained hypothermal deposits where the tungsten is associated with pegmatite minerals, pyrrhotite and arsenopyrite, and a type that is definitely epithermal with a gangue of opal and carbonates. Antimony mining is carried on by still smaller units—usually 2 to 20 men—operating intermittently.

Bolivia's mining industry is doing well, but the country wonders what will happen after the war when the markets are glutted.

PERU—This country presents a picture of steady progress. Cerro de Pasco has continued shipping copper and lead as well as tin and bismuth. Production of vanadium from Minasragra has been well maintained, and the small quantities of molybdenite (Ricran mine, Department of Junín), tungsten (Department of Ancash) and manganese (in the Department of Puno) have shown notable increases.

Gold, however, has continued its rise begun when the price was increased. Although Cerro de Pasco produces a large part of the total, the remainder comes from rather small mines, many of which are capitalized in Lima in whole or in part. Outstanding among them are: Nazca, in the Department of Ica, with a 200-ton cyanide plant, and Julcaní, in the Department of Huancavelica, which opened its 150-ton mill in February, 1941. Placers are increasingly attracting the attention of Peruvian mining men, particularly in the region which drains to the Amazon in the southeast part of the country. This area is gradually being opened as roads are built over the mountain passes to reach it.

ECUADOR—The South American Development Co. is now producing 6,000 oz. of gold a month from 15,000 tons of ore at its Portovelo mine; and the Cotopaxi extracts 2,800 oz. from 9,000 tons of ore. The Portovelo mine has lately been handicapped by the occupation of its port on the Gulf of Guayaquil by Peruvian forces, which has restricted its communications to a four-day mule ride to Cuenca. Mining shows promise in Ecuador, though so much of the basement is covered by lava, ash, and recent sediments that possible mining areas are strictly limited.

COLOMBIA—Mining in Colombia is gold mining, for, although deposits of siliceous manganese (at Apía, Caldas), chromite (at Medellín), iron, antimony (at Villa Maria, Caldas), and copper (at Salgar, Antioquia) have attracted attention, gold is the only metal produced in quantity. About 60 percent comes from alluvials. Production is now about 23,000,000 Colombian pesos, each worth about 60 to 66c. U. S. currency. This production will decrease as the alluvials are worked out and costs rise in the quartz mines.

VENEZUELA—In Venezuela the New Goldfields company has managed to keep production up to its program. Changes in the flowsheet have brought extraction to over 90 percent. It is now driving to connect the Union and Sosa Mendez mines so as to work them as a unit. In April, 1941, excitement was caused by announcement of the discovery of cinnabar near Carora. So far no production has been had.

COLONIES—Continued operation of the Guiana bauxite mines was assured by the advent of United States troops in November 1941. The Curaçao phosphate deposit, closed in 1939 when its Baltic markets were cut off, has been reopened and is now shipping to England.

1938. This accord also provided for a loan to Mexico of $40,000,000 to insure stability of the peso, which, as it was, had remained at approximately 4.85 to the dollar throughout the year; also for a credit for another $30,000,000 for road-building; and further stipulated that Mexico would pay $40,000,000 for United States citizens' claims aside from oil.

Of the major non-ferrous metals, Mexico appears to have produced less lead and silver in 1941 than in the year before and more copper and zinc. The interested reader is referred to the various production tables accompanying the respective reviews of these metals on pages 42-56.

Wages paid by the principal operating companies averaged approximately the same as in 1940, although over-all labor costs were higher, thanks to obligations in favor of workmen imposed by the collective contracts. Machinery for mining enterprises became increasingly difficult to secure, save where priorities granted in the United States favored new and strategic projects.

Appraisal of the value of certain metals for the 12 percent export tax underwent some changes during the year. Refined lead was exempt from this tax from Jan. 1 up to Nov. 20, when the Government began again to collect it, the appraisal value being fixed at 0.121 peso per kilogram. The appraisal value for copper was altered five times: up until March 20 it was 0.40 peso per kilo and from then until April 20, 0.404; on the next day it was lowered to 0.392. The following month on May 21 it was raised again to 0.404 and on June 21 to 0.409, remaining there until Nov. 21. On the latter date it was more than doubled, being put at 0.842. This was the value of refined lead for appraisal at the year's end.

In contrast, the appraisal value for zinc in concentrates was stationary at 0.54 peso per kilogram until Nov. 21, when it was lowered to 0.158, where it remained until Dec. 21, being then raised to 0.175. As may be surmised from the foregoing, the appraisal values are fixed for periods beginning on the twenty-first of each month and ending on the twentieth day of the following one.

Silver had been exempted from the export tax on May 21, 1940, and retained this favored position throughout 1941. In comparison, the appraisal value of gold remained fixed at $2,498.39 pesos per kilogram during the year.

The tax burden borne by the operators otherwise remained about the same. The income tax on excess profits was repealed but will be paid on those earned in 1941. New income tax legislation, however, imposing higher rates which are to be effective Jan. 1, 1942, was enacted.

CENTRAL AMERICA

Stable conditions favor the mining industry in these Republics. Communications much improved. Gold is the principal metal produced

John B. Huttl
Assistant Editor

HIGHER PRICES FOR METALS, particularly gold; political stability, and improved communications have made mining and prospecting in Central America decidedly more interesting. For several years the political situation in the five republics has been stable, and with the advent of the "Taca" aerial transport service, quick travel and transportation of equipment and materials at reasonable cost to areas formerly difficult to reach have become a reality. The supply of labor is satisfactory, and unless serious obstacles arise in the near future as to delivery of machinery, replacements, and materials from the United States, mining in Central America should continue to enjoy a moderate and healthy expansion.

The country that has seen a considerable growth in its mining industry in recent years is Nicaragua. Gold is the chief metal recovered, and 1941 production is estimated at more than $7,000,000. The most active districts are Madriz, Leon, Chontales, and Matagalpa. La Luz Mines, Ltd., and Neptune Gold Mining Co., which currently contribute the major part of Nicaragua's gold output, are in the Madriz district. In Leon, La India and El Limon mines are active, the latter a new producer, and in the Chontales area San Juan Mining Co. and three other properties are producing steadily. La Reina is active in the Matagalpa district. Coco Mines, Ltd., recently completed a 500-ton gravity concentrator at its property near San Carlos, on Rio Coco. The mine contains a large tonnage of low-grade, free-milling gold ore, and is situated in the northeastern part of the republic, with Puerto Cabezas as port of entry. Though other metals are available in Nicaragua, all current mining centers on gold.

In Honduras, the New York & Honduras Rosario Gold Mining Co., at San Juancito, continues to be the principal producer. Milling facilities include a 550-ton cyanide plant. Annual production amounts to about 4,000,000 oz. silver and 20,000 oz. gold. The property is one of the oldest in Central America from the standpoint of continuous production, and operations are being expanded steadily. The Agua Fria mine, with a 125-ton flotation mill, is near Danli, and underground operations during the past years were centered chiefly in exploratory work. Small-scale operations are reported from the old Porvenir mine. Some gold comes from native placers.

Annual production of gold in Costa Rica exceeds $550,000, which is from many small-scale operations. The Abangarez concession continues the largest contributor followed by the Rudin mines, in the Miramar district. The Aguacate area produces about 20 percent of the annual gold output. Producers in the district include the Compañia mine, with its new 40-ton concentration-flotation plant, and La Union mine, operated by Juchem and Sanford. Prospects under development are the Britannia, Corazon de Jesus, Calera, Las Luzes, and Llano Brenes. Sporadic work is carried out by native miners on the placers of Golfo Dulce and the Osa Peninsula. The manganese and sulphur deposits in the Guanacaste district remain idle. There are also some known deposits of lead and copper.

Mining in El Salvador is confined to the Departments of San Miguel, La Union, and Morazan. Mines active during the year included Minas Montecristo, Potosi, San Sebastian, and Hormiguero—practically all gold producers. Milling plants at these properties vary from 65 to 40 tons. Iron, copper, zinc, and lead deposits are found in the Department of Santa Ana. Discovery of molybdenum near Taputla has been reported recently.

AUSTRALIA

Mining industry finds costs rising, labor scarcer, and taxation becoming heavier. Metals output sustained

Peter G. Tait

Melbourne, Australia

AUSTRALIAN MINING faced difficulties during 1941, arising from decreasing labor supply and increasing costs of wages and stores, to which have been recently added greater burdens in the form of a payroll tax in support of family endowment and new income-tax provisions which seriously threaten the efficient life of the industry.

Although steps have been taken to safeguard the needs of the mining industry in regard to manpower, an adequate supply of labor is becoming increasingly hard to find. Many companies are now faced with the problem of keeping up maximum output while carrying on sufficient development to maintain the tonnage of reserves, rendered difficult by loss of men by enlistment, call-up for military training, and drift to munitions work. Not only are actual production and development affected, but also the supply of timber and wood fuel, extensively used in many localities. Rationing of gasoline is causing inconvenience, but the situation is being eased by the application of charcoal-burning producer-gas equipment to transport vehicles.

Taxation of the mining industry does not appear to be directed with the degree of foresight desirable for maintenance of production and the encouragement of the search for, and the development of, new mines. Gold mining has been favored, for this branch of the industry has been exempted from taxation, excepting the incidence of the gold excise, which is remitted in the case of high-cost mines until the subscribed capital of the company has been repaid, while calls paid to mining companies have been allowed as deductions from taxable income. Base-metal mining has not been so favored. Though the deduction of calls from income has been allowed, profits have been limited to 8 percent before the application of war-time profit tax. New taxation proposals include the withdrawal of the exemption of taxation on calls and the reduction of the profit margin in base-metal mining to 4 percent. As the search for mineral deposits and their exploration are essentially activities of the private individual, there is strong ground to fear that the new taxation provisions will seriously influence the industry by discouraging the search for new deposits by reason of the totally inadequate allowance and consideration to the investor for the high degree of risk involved.

Mineral production throughout the Commonwealth has continued at a level corresponding to that in 1940 despite the difficulties cited. There have been no discoveries of importance, but new consideration is being given to the production of aluminum and magnesium. Extensive deposits of bauxite in New South Wales, Queensland, and Western Australia have been examined and magnesite occurrences in New South Wales, South Australia, and other localities in the Commonwealth and plans for the output of metallic aluminum and magnesium are well advanced.

As a war-time measure, production statistics of base metals are no longer published and the activities of companies engaged in base metal mining therefore lack some of the usual interest.

WESTERN AUSTRALIA — The gold yield for the State, to Oct. 31, was 920,215 oz., which shows a decrease in comparison with 1,010,734 oz. in the first nine months of 1940, in which year 1,154,843 fine oz. was won.

Ore reserves in the Kalgoorlie field show improvement in most mines. In Lake View & Star, Ltd., the last available figures show 3,854,400 tons of 5.39-dwt. ore; Gold Mines of Kalgoorlie, 646,000 tons, assaying 5.0 dwt. per ton; Boulder Perseverance, Ltd., 490,300 tons running 6.18 dwt.; Kalgoorlie Enterprise Mines, Ltd., 422,800 tons assaying 6.46 dwt., and Great Boulder Proprietary, 1,632,000 tons carrying 5.5 dwt. gold per ton.

Figures recently published on grade of ore mined and tonnage produced per employee show that in 1897 the average value of ore treated was 28 dwt. per ton and the quantity per man 23 tons. In 1903, the peak year in the State's history, the average grade had fallen to 18 dwt. and the rate of production had risen to 125 tons per man. By 1913, grade had dropped to 9.3 dwt. and output had advanced to 214 tons per man. In 1940 grade had decreased to 5.28 dwt. per ton and the rate of production was 298 tons of ore, or 80 oz. of gold, per man engaged in mining both underground and on surface. The average output per man employed underground was 525 tons in which regard 913 tons per underground employee was raised on the East Murchison field, containing the Wiluna mines, 735 tons on the Murchison field, where Big Bell and Triton mines are operating, and 655 tons in the Kalgoorlie district, which contains the deep mines of the Boulder area.

Wiluna Gold Corporation, Ltd., with ore reserves of 1,186,000 tons assaying 3.8 dwt. per ton, has had indifferent development results and has been looking for a new property. An option for two years has been taken on the Mount Charlotte Kalgoorlie Gold Mines, near the north end of the Kalgoorlie belt. The purchase price is believed to exceed £A200,000. The mine was originally opened up in the early days of the field to a depth of 500 ft. and diamond drilling carried out in recent years has indicated 1,122,000 tons of ore having a value of 5.36 dwt. gold per ton. The maximum width disclosed in these operations was 40 ft.

South of Southern Cross, Burbidge Gold Mines is working an extensive low-grade lode formation, about 100 ft. wide, with extensions of auriferous laterite. The lode has been opened to 280 ft. but operations are confined to open-cut work, using a mechanical shovel. The orebody has been proved for a length of 900 ft. and the grade is 2.8 dwt. per long ton. Treatment is by dry-crushing and leaching, giving 90 percent recovery. Total mining and treatment costs are 11s. (Aust.) per ton. Present plant capacity is 4,000 tons per month, but the deposit is held to be capable of a greater output.

Much attention is being given to non-metallic minerals. High-quality feldspar is being mined near Cool-

gardie and at Bulong an important deposit of vermiculite is being developed. Examination of asbestos occurrences in the State shows that those in the Hamersley Ranges are extensive and contain high-quality fiber. The mineral is crocidolite and occurs over a length of 180 miles, the belt being 20 miles wide. The occurrences are exposed in the sides of gorges, which intersect the ranges and conditions for exploitation are therefore very favorable. The region is remote, but the coast can be reached within a distance of 170 miles.

NEW SOUTH WALES — Operations at Broken Hill have been conducted in the usual efficient manner by the North Broken Hill, Broken Hill South, and the Zinc Corporation companies, the most notable feature being improvement in the already high metal recoveries.

At the North Broken Hill mine, the plat at the 2,770 ft. level of No. 2 shaft has been cut but no development was carried out at this horizon. General mine development was satisfactory, operations being mainly confined to the 2,000, 2,150, and 2,300 ft. levels. The main feature of the mining operations has been the continued success attaching to the extraction of ore from lode pillars, and during the last operating period 23.8 percent of the ore mined in the North section was won from this source. In the concentrator the metal recoveries were: lead, 96.2 percent; silver, 90.5 percent; and zinc, 86.0 percent. Treatment comprises jigging and tabling for granular lead recovery and flotation for fine lead and zinc. Ore reserves were 5,232,000 long tons. Broken Hill South, Ltd., has reserves of 2,250,000 tons, exclusive of ore disclosed by diamond drilling only, by limited development work, or ore below the 1,480-ft. level. In underground operations the outstanding feature was the introduction of the hydraulic system of filling stopes. Use of Australian hardwood underground is being extended to conserve stocks of Oregon timber. Crude ore treated in 1941 was of slightly lower grade than in the previous year, but this was offset by improved metallurgical work. Treatment is similar to that on the North Broken Hill mine. Recoveries were: lead, 96.1 percent, as in the previous year; silver, 92.2 percent, an increase of 0.7 percent; and zinc, 89.1 percent, an increase of 0.4 percent. The latest available figures show ore reserves of 3,650,000 in the mine of Zinc Corporation, Ltd. Diamond drilling continues to be employed extensively in exploration, and at 2,700 ft. from surface, a recent intersection showed ore carrying 19 percent lead over a width of 120 ft. The three Broken Hill companies are jointly engaged in extensive community services which include picnic grounds, sports grounds, plantations in and around the city, and the maintenance of an aero club. Recent interests include technical training of unemployed youth, the provision of social halls, tennis courts and children's playgrounds, and important financial contribution has been made to the new hospital.

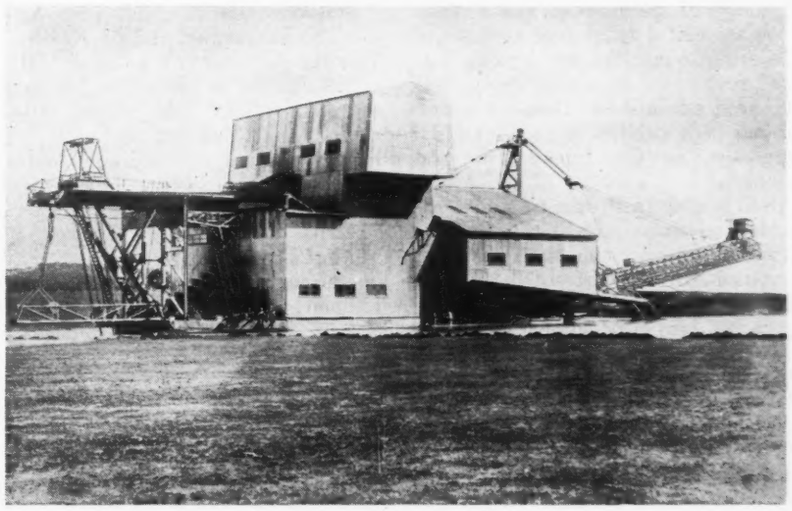
A new gold producer is Broken Hill Proprietary's Cowarra mine, near Cooma. Ore sorting is introduced prior to milling, by which the monthly output of 4,000 tons is reduced to 3,000 tons of milling ore, three men being so employed. Closed-circuit crushing is used and a uniform product delivered to the ball mills in which primary and secondary grinding is practiced. Treatment is by agitation, filtration on Oliver filters, and Merrill-Crowe precipitation. Strakes are a feature and 20 percent of the gold is thus recovered. Primary grinding effects a reduction from ½ in. to 1/32 in. and the product from secondary grinding is 90 percent minus 200 mesh.

The State's largest gold mine, New Occidental, at Cobar, continues to develop remarkably well. The main shaft has been sunk to 1,574 ft. and reserves of proved and prospective ore total 882,000 tons, of which 453,000 tons of positive ore has a grade of 7.9 dwt. gold per ton. In the company's adjacent New Cobar mine, reserves are 225,000 tons assaying 7.6 dwt. gold and 0.95 percent copper. Extensions to the power plant are being completed and the tonnage from New Occidental is to be increased. This mine produces 97,000 tons of ore annually and New Cobar 51,000 tons. New Occidental's gold recovery is 88.8 percent, with residues assaying 0.82 dwt. per ton. New Cobar's recoveries are gold 81.4 percent and copper 97.3 percent. Working costs, in Australian currency are 34s. 11d. and 42s. 10d., respectively.

VICTORIA—Gold production in the State decreased in 1941, due in part to the decline in grade in two of the largest Bendigo producers, Deborah and Central Nell Gwynne. There has been a general attitude of disappointment toward this old, productive gold field, arising from the failure of new flotations and reopened mines to realize optimistic expectations. A number of such companies, originating from the phenomenal successes of a few mines, had little or no geological justification for existence. The Daylesford field has been encouraged into new exploration by the Maxwell Consoliated mine, which is working, among others, a large, flat orebody 600 ft. long, 100 ft. wide, and 10 ft. thick, as disclosed. Ore mined over nine months has averaged 15 dwt. gold per ton. Reserves are equivalent to three years' output and development prospects are good. Following this lead, three other mines have started work and one mine is opening up 12-dwt. ore. In Bendigo, the leading position is held by North Deborah Gold Mines which is maintaining an average grade of 22 dwt. gold. Deborah Gold Mines, for some years a leader with 15-dwt. ore, has declined to a 6-dwt. grade and the Central Nell Gwynne mine shows average values of 4.3 dwt. per ton. Consistent returns are shown by Wattle Gully Gold Mines, with 7 dwt. per ton and an output of 2,500 tons per month. The outstanding alluvial mine continues to be Victoria Gold Dredging, N. L., which is treating 200,000 cu.yd. of ground per month, for an average recovery of 2.7 gr. gold per cubic yard. Other consistent lode mines are Morning Star and A.1 Consolidated, in the Woods Point country, and Chewton Gold Mines appears likely to become prominent.

SOUTH AUSTRALIA—Two projects at Broken Hill Associated Smelters, at Port Pirie, are reported. One pertains to the accumulation of granulated blast-furnace slag containing 15.78 percent zinc and minor quanti-

The bucket dredge of Victoria Gold Dredging, N. L., at Newstead, is accounting for an appreciable addition to the Commonwealth's annual gold output



ties of lead and silver. Research into the recovery of these metals is proceeding. The second project concerns the utilization of the higher sulphur-bearing gases for production of elemental sulphur.

QUEENSLAND—Leaders in Queensland mining are Mt. Morgan and Mt. Isa. Mt. Morgan is still engaged in removal of overburden to permit the open-cut mining of 7,000,000 tons of gold-copper ore to a depth of 800 ft. from surface. Many difficulties were met during the year: an abnormal wet season greatly hampered the excavation operations, and much ore, subjected to intense heat in the old mine fire of some 20 years ago, was found to have been roasted to calcines. This material was very acid and difficult to mine and treat, particularly under wet conditions. Overburden removed and dumped was 1,364,887 tons. A great part of the ore treated was auriferous overburden, and although the grade was much lower than formerly, a working surplus of £A159,000 was earned after meeting all operating expenses. Working costs for mining and treating the sulphide ore were 10s. 11d. per ton and for oxide ore they were 2s. 8d. per ton.

Mt. Isa Mines, Ltd., has continued a steady output of lead bullion and zinc concentrate. It is about to become a copper producer with financial assistance from the Commonwealth Government. Exploration has disclosed a bed of dolomitized shale with pyrite and chalcopyrite, 200 ft. wide, which has, so far, been shown to persist to 1,250 ft. from surface. The annual output is expected to be 5,000 tons.

Australia

To stimulate production of copper in Australia, the price of metal has been increased to £A86 10s. per ton, and a survey of copper resources is being made. An important forward step is the unwatering of Mt. Chalmers mine. Reserves are stated to be 400,000 tons and an annual output of 2,000 tons of copper is anticipated. The ore will be treated at the Mt. Morgan plant of Mt. Morgan, Ltd.

TASMANIA — The State's three large mines continued usual production. Mt. Lyell mined and treated copper ore to plant capacity, most of the ore, as usual, being won from the open cut. Average grade was lower by 0.05 percent copper, which affected the output of metal. Despite the large tonnage mined, ore reserves were 162,000 tons higher than at the close of the preceding year and were estimated at 10,620,000 long tons, of an average value of 1.47 percent copper, 0.11 oz. silver, and 0.013 oz. gold.

At the West Coast mines of Electrolytic Zinc Co., shift work has been eliminated at the Rosebery mine and the general position has been helped by increased mechanization underground and on surface. Limitation of mining and development to one shift has been made practicable by the active development policy of recent years. Reserves, including "reasonably probable" ore, are put at 1,500,000 tons, ore disclosed balancing the tonnage mined during the year.

Briseis Consolidated is still the big tin producer of the Commonwealth. Sluicing was continued uninterruptedly. Approximately 65,000 cu.yd. of drift was sluiced per month and a monthly output of almost 50 tons of tin oxide maintained. Costs for overburden removal are 13 pence per cubic yard and for drift sluicing 16.5 pence per cubic yard.

NEW GUINEA—During nine years' operations to April, 1941, Bulolo Gold Dredging, Ltd., has established the following record: Ground dredged, cu. yd., 105,892,650; gold bullion won, oz., 1,714,431; gross value of production, £A9,970,848; working profit, £A6,728,250. Unworked ground amounts to approximately 164,600,000 cu.yd. and monthly output is between 1,400,000 and 1,600,000 cu.yd. of alluvium.

Canada

(*Continued from page* 63)

Consolidated Mining & Smelting Company of Canada, tin production to the extent of about 500 tons a year has been made possible as a byproduct of the complex ore of the Sullivan mine. Smelters have also led the way in this country for the production of mercury. In a year the mine at Pinchi Lake has developed from the experimental stage to a plant that treats 800 tons of ore daily. Research on cadmium, another byproduct of the Sullivan, has shown it to be associated with some sections of zinc ore in quantities up to $24 a ton. The presence of indium in the ore has also been established. Base-metal output has been swelled by such marginal properties as the Lucky Jim and Monarch.

Gold mining in British Columbia expanded moderately during 1941, with 33 producers operating mills having a combined daily capacity of 5,465 tons. Bralorne and Pioneer brought adjoining mines into production in the new Bedwell River district on Vancouver Island, and on the west coast of the island the recently opened Zeballos camp maintained its record for high-grade ore. What may prove to be the most important gold discovery of 1941 in Canada was a strike made by Bill White in the Yalacom district, northwest Lillooet. Dragline dredging was introduced on a scale larger than ever before in the province. Tungsten, although widely distributed, has not been seriously developed until the recent work was started on two properties by Consolidated Mining and Smelting Company. Canada's war effort is to be aided by bringing these into production as soon as possible. Two copper mines in the province have a daily output of 11,000 tons; six mills with a combined capacity of 8,500 tons daily are treating silver-lead-zinc ores.

Mid-West Canada, including Manitoba, Saskatchewan, and the Northwest Territories, produced minerals valued at $26,036,536 in 1940. The ten metals represented were gold, silver, copper, zinc, lead, selenium, cadmium, tellurium, radium and uranium, natural gas, and crude petroleum (the last four from Northwest Territories). Although Sherritt Gordon and Hudson Bay Mining & Smelting are the two major operators in this great region, the development has taken place within the last 15 years. Minerals produced in 1926 were valued at only $3,897. Developments in the Yellowknife mining area have led to the recovery of more than $6,000,000 worth of gold, with five mines operating and another mine to be ready for production early in 1942. All but two of the mines are controlled by Consolidated Smelters, which also operates the important Box mine, on Lake Athabaska. Adverse mining regulations are blamed for the limited activity in opening up this area of potential wealth. The mining of bituminous sands in northern Alberta started on a commercial basis last May, the products being sold to Consolidated Mining & Smelting Company. The plant at Fort McMurray treated 4,027 tons of sand in September to produce 3,440 barrels of crude, 192 barrels of gasoline, and 1,162 barrels of diesel and burner oil. The tar sands are known to cover an area in excess of a thousand square miles, with an average thickness of 150 ft., with an oil content that is estimated to be upwards of 100 billion barrels.

In New Brunswick and Nova Scotia coal and gypsum are the chief mineral products. Production from small-scale gold mines will probably show a decline in 1941 and prospects are not encouraging. Coal increased last year 14 percent over 1939 and expansion in 1941 is indicated as continuing. This is also true of gypsum. The Maritime Provinces have important production of salt, lime, and other non-metallics. Two manganese properties have been developed and concentrators installed, each of 100 tons' capacity. The search for strategic minerals is being encouraged here, as elsewhere.

SOUTH AFRICA

Gold mining on Rand makes new records in metal output and tonnage mined. Average grade milled reveals a decline

S. N. Hoffenburg

Department of Mining Engineering
University of the Witwatersrand
Johannesburg, South Africa

AS USUAL, South African mining signifies mainly the gold-mining industry. The latter, in turn, refers primarily to that part of the industry concerned with the Witwatersrand. For example, the total mineral wealth produced in the Union of South Africa in 1940 totaled £130,000,000; the gold-mining industry accounted for 91 percent of this production, coal coming next on the list, with 4 percent, and diamonds third, with only 1 percent.

At the time of the last annual review (written in November 1940) the final results for the year were not available. A résumé, therefore, of the results for 1940 provides a useful background against which results to date (November 1941) may be viewed.

Results for 1940 of the Witwatersrand gold-mining industry were outstanding. New records were achieved in every direction. Before departure from the gold standard (1932) the year's output of gold was valued at just under £50,000,000 for the whole of the Transvaal. In 1940, the value of the production was £117,990,572, when producing mines spent £66,682,366 in working costs, representing an advance of over £10,000,000 on the figure for 1939 and exactly twice as much as in 1932.

Table I—Operating Results for Witwatersrand Gold Mining Industry, 1939 and 1940

Item	1939	1940
Tons milled	58,340,200	64,515,350
Yield—fine ounces gold	12,495,111	13,683,418
Dwt. per ton milled	4.234	4.196
Working revenue (total)	£92,126,373	£114,207,553
Working revenue per ton	31/7	35/5
Working costs (total)	£56,609,412	£66,682,366
Working costs per ton	19/5	20/8
Working costs per ounce gold	91/8	98/6
Estimated working profit	£35,516,961	£47,525,187
Working profit per ton	12/2	14/9

Taxation figures are even more striking. In the financial year ended March 31, 1933, the mines contributed £3,600,000 in direct revenue to the State. In the following year, after the gold standard had been abandoned, this contribution rose steeply to some £14,500,000. At the end of March, 1941, the gold-industry contributed more than £26,700,000 to Government revenue.

Gold production rose from 11,553,564 fine ounces in 1932 to 14,037,741 oz. in 1940. Profits rose too. The whole industry showed a profit of £14,700,000 in 1932, £35,516,961 in 1939, and £47,525,187 in 1940. In 1932, £8,993,294 was paid out in dividends, £19,903,321 in 1939, and £20,359,487 in 1940.

Despite the fact that the mines now add realization charges to working costs, this figure, 20s. 8d. per ton milled in 1940, showed an advance of only 1s. 5d. over the figure for 1932. The smallness of this increase is due mainly to the vastly increased tonnage milled.

On the other hand, however, the mines are now milling a grade of ore very much lower than when the standard price of gold prevailed. The average grade in 1932 was 6.741 dwt./ton. In 1940 this had been lowered to 4.196 dwt./ton milled. But revenue per ton rose from 27s. 6d. to 35s. 5d., due to the higher price of gold. In the same period, profit per ton milled rose from 8s. 4d. to 14s. 9d.

The remarkable advances in 1940 over 1939 by the Witwatersrand gold mining industry are given in Table I.

The total quantity of gold, in fine ounces, produced in the Transvaal in 1940 was 14,037,741 oz., contributions from districts outside the Witwatersrand being 354,323 oz., compared with 324,233 oz. in 1939 in a total for the Transvaal of 12,819,344 oz. There was an increase in tonnage milled on the Witwatersrand of 6,175,150 tons in 1940, due to new producers, plus extensions to some existing plants. The yield was 1,218,397 higher than in 1939, but average recovery per ton showed a reduction of 0.038 dwt.

The following data indicate the magnitude of the operations and results obtained by some of the well-known Rand producers in 1940:

Randfontein Estates milled 4,704,000 tons in 1940, followed by Crown Mines, with 4,168,000 tons, and Government Areas, 2,845,000 tons. Then followed West Rand Consolidated Mines (2,781,000 tons), East Rand Proprietory Mines (2,647,000 tons), and Consolidated Main Reef Mines (2,404,000, tons).

Crown Mines headed the list with a production of 1,008,546 fine ounces, followed by Randfontein Estates (686,056 oz.), Government Areas (554,807 oz.), East Geduld (549,307 oz.), and Daggafontein Mines (546,080 oz.).

The average cost of production per fine ounce was 98s. 6d. in 1940. Of the 44 producers, 29 had a cost above this average. The highest working costs per ounce of gold produced were returned by Langlaagte Estates (151s. 11d.), the lowest by Sub Nigel (55s. 5d.).

In view of the great increase in the cost of gold production on the Witwatersrand (from approximately 60s. an ounce fine under gold standard conditions to 103s. 8d. at present), it is interesting to compare the average recovery per ton milled now by individual mines with their recovery before suspension of the gold standard.

Ever since the first increase in the price of gold the mines have increased

Table II—Grade of Ore Milled by Mines: Prior to leaving Gold Standard and at Present

Name of Mine	Dec., 1932 (Dwt./ Ton)	Oct., 1941 (Dwt./ Ton)	Decrease (Dwt./ Ton)
Brakpan Mines	6.866	4.315	2.551
City Deep	5.297	4.549	0.748
Consolidated Main Reef	6.910	3.016	3.894
Crown Mines	6.528	4.482	2.046
Daggafontein Mines	6.528	5.657	0.871
Durban Deep	8.135	3.601	4.534
East Geduld Mines	6.234	5.734	0.500
East Rand Ppty	6.416	4.001	2.415
Geduld Ppty. Mines	5.277	4.755	0.522
Geldenhuis Deep	6.480	2.513	3.967
Government Gold	4.771	3.875	0.896
Langlaagte Estates	8.946	2.644	6.302
Luipaards Vlei	6.238	4.162	2.076
Modderfontein "B"	4.997	3.440	1.557
Modderfontein Deep	5.433	2.501	2.932
Modderfontein East	9.227	3.273	5.954
New Kleinfontein	5.558	3.467	2.091
New Modderfontein	4.003	2.701	1.302
New State Areas	7.049	4.724	2.325
Nourse Mines	9.760	3.974	5.786
Randfontein Estates	5.914	2.886	3.028
Robinson Deep	5.882	4.247	1.635
Rose Deep	4.201	3.074	1.127
Simmer & Jack	3.754	3.357	0.397
Springs Mines	9.615	5.355	4.260
Sub Nigel	17.965	12.341	5.624
Van Ryn Deep	6.217	2.608	3.609
Van Ryn Estates	4.411	2.264	2.147
West Rand Consol	5.252	3.735	1.517
West Springs	4.725	4.312	0.413
Witwatersrand Deep	4.815	3.062	1.753
Witwatersrand Gold	3.696	2.904	0.792

Table III—Results Achieved by the Gold Mining Industry of the Rand and Its Extensions in 1941

	January	February	March	April	May	June	July	August	September	October
Number of producing mines	44	44	44	44	44	44	45	45	45	45
Tons milled	5,598,900	5,190,200	5,633,600	5,416,500	5,730,100	5,521,750	5,786,400	5,683,100	5,621,400	5,799,500
Total fine ounces gold produced	1,211,271	1,129,975	1,199,476	1,166,456	1,219,068	1,181,255	1,225,772	1,212,708	1,203,353	1,235,784
Pennyweight per ton	4.164	4.201	4.120	4.168	4.112	4.120	4.087	4.109	4.128	4.093
Declared revenue, total (£)	9,824,382	9,187,224	9,777,954	9,526,921	9,932,322	9,585,058	9,967,576	9,837,878	9,775,972	10,019,252
Declared revenue per ton	35/1	35/5	34/9	35/2	34/8	34/9	34/5	34/7	34/9	34/7
Total working costs (£)	5,828,651	5,516,912	5,880,222	5,771,325	6,024,506	5,790,624	6,085,705	6,007,444	6,013,702	6,153,258
Working costs per ton milled	20/10	2/13	20/11	21/4	21/0	21/0	21/0	21/2	21/5	21/3
Working costs per ounce gold produced	100/0	101/3	101/4	102/3	102/3	101/10	102/11	102/11	103/8	103/8
Declared estimated working profit (£)	3,995,731	3,670,312	3,897,732	3,755,596	3,907,816	3,794,434	3,881,871	3,830,434	3,762,270	3,865,994
Declared working profit per ton milled	14/3	14/2	13/10	13/10	13/8	13/9	13/5	13/5	13/4	13/4
Number of Europeans employed	41,469	41,470	41,643	41,647	41,619	41,533	41,470	41,371	41,248	41,233
Number of colored employees	357,831	373,094	375,528	374,787	373,919	369,684	367,520	367,891	368,498	367,291
Wages and salaries, whites (£)	1,624,387	1,526,148	1,609,224	1,626,966	1,652,022	1,597,584	1,666,004	1,616,716	1,722,405	1,684,988
Wages, colored (£)	1,088,560	1,015,490	1,102,639	1,104,195	1,135,387	1,053,928	1,119,060	1,085,680	1,086,617	1,120,815

milling capacity and have milled a consistently lower grade of ore. The life of the industry, at the present scale of milling, could not be maintained for long were the original grade of ore to the mill maintained. Selective mining would produce a moderate increase in grade temporarily; but the tonnage milled would decline. Any small temporary advantage that shareholders might enjoy through milling ore of higher grade would be offset largely by the much higher rate of taxation payable to the Government under the graduated tax that is based on the ratio of profit to recovery.

The present policy of milling a maximum tonnage of a minimum economic grade, therefore, serves to prolong the life of the industry and conserves large tonnages of payable ore for the post-war period, when gold will probably play a still more important rôle.

South Africa

During 1941 the gold-mining industry achieved a whole series of new records. Monthly and (estimated) yearly tonnages exceed those for 1940, and gold production, working revenue, and working expenditure also exceed those for any previous period. The average grade of ore milled reached a minimum during the year. Details of results to date are given in Table III at the top of this page.

The average grade of ore milled to date (October) was slightly in excess of 4.1 dwt. per ton, and the estimated tonnage for the year will exceed 67,000,000. The estimated gold production should exceed 14,350,000 oz., valued at just over £120,000,000.

Last year's mineral production is bound to be exceeded and the proportion due to gold should be somewhat higher. Already for the first six months of 1941 the Transvaal output was 206,482 oz. in advance of that for the corresponding period of 1940. These noteworthy results have been attained despite the fact that many experienced European employees have joined the colors and that the mines are producing a large volume of munitions.

Coal-mining operations are expanding, due to industrial expansion and an increased demand for bunker coal. The diamond-mining industry is at a comparative standstill with large stocks of diamonds available to meet all demands. In short, the population of the Union of South Africa, though more than two million Europeans in all, is thriving—thanks largely to its mining industry.

United States

(*Continued from page* 60)

in Tooele County; and the New Park, in the Park City region. Each of these properties produced over 2,000 tons of recovered zinc and together they accounted for 88 percent of the State output.

The Bureau reports a total of about 31,714,000 tons of Utah ore was treated in 1941, compared with 27,939,346 tons in 1940. Most of the gain was in copper ore from the Bingham district. In 1941 there were about 175 lode mines and 19 placer mines in operation, compared with 191 lodes and 21 placers in 1940. Gold from placer operations is relatively unimportant; the production is calculated to have been 589 oz. and 109 oz. silver in 1941.

CENTRAL STATES—Mining in Arkansas, Illinois, Kansas, Kentucky, Michigan, Missouri, Oklahoma, and Wisconsin, all grouped in the above heading, improved greatly in 1941, and prospects for a considerable increased output in 1942 are virtually assured. A few highlights on mining activities based on metals produced from reports by the Bureau of Mines show that silver produced in these states in 1941 was recovered as a byproduct of the mining of base-metal ores. Lead ore from Missouri yielded 351,000 oz., copper ore from Michigan 54,000 oz., and zinc-lead-fluorspar ore and byproduct lead concentrates recovered in the milling of fluorspar from Illinois, 19,990 oz.

Copper production comes principally from Michigan, where four companies produced about 46,535 tons of recoverable copper. The copper reported from Missouri, being 1,060 tons in 1941, was derived from the treatment of residues from the smelting of lead concentrates from southeastern Missouri.

The southeastern Missouri disseminated-lead district district yielded 79 percent of the total output of lead in the Central States in 1941, and the Tri-State region (Kansas, southwestern Missouri, and Oklahoma) produced 94 percent of the zinc and 20 percent of the lead. Other states in the central group producing lead and zinc were Arkansas, Illinois, Kentucky, and Wisconsin.

EASTERN STATES—Nine states, Alabama, Georgia, New Jersey, New York, North Carolina, South Carolina, Pennsylvania, Tennessee, and Virginia, make up this group, which reported material gains in 1941 metal output. The total metal production for this group is shown in the table on page 59.

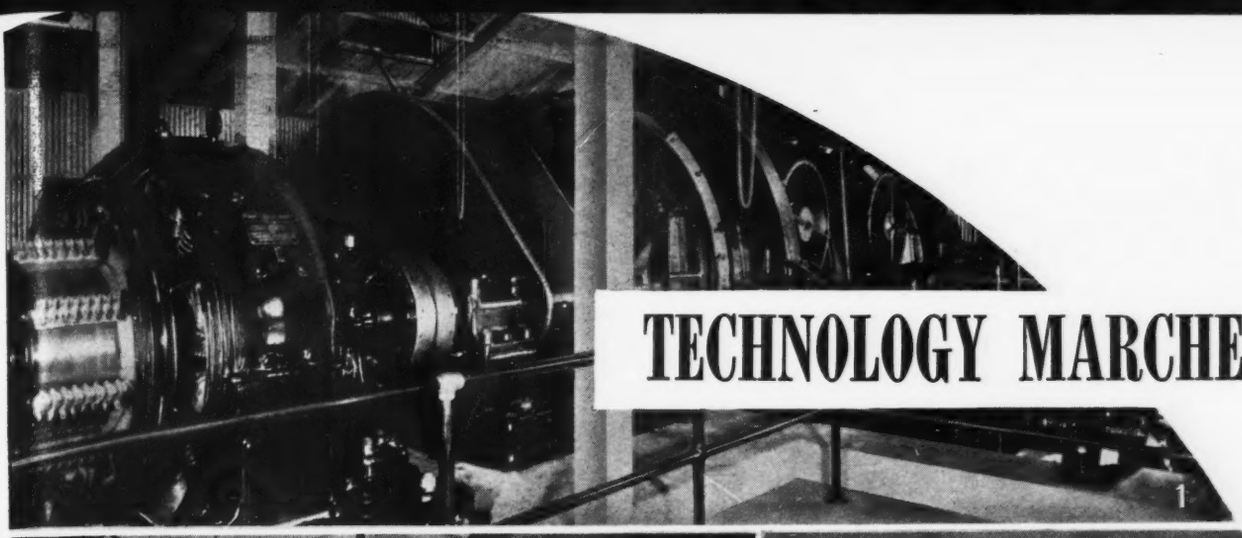
Gold production from North Carolina, Pennsylvania, and South Carolina contributed about 96 percent of the total output for this group. The leading gold mine in the Eastern states was the old Haile mine, near Kershaw, S. C. Production in North Carolina also increased and Pennsylvania produced 2,675 oz. in 1941, all as a byproduct from the Cornwall magnetite-pyrite-chalcopyrite mine, in Lebanon County.

Silver was derived as a byproduct from mining other metals such as copper ores in Tennessee and lead zinc ores in New York State. Gold ore and placer gravels from South Carolina, North Carolina, Georgia, Virginia, and Alabama accounted for 8,285 oz. silver in 1941.

The copper produced in the Eastern Stafes came from the Tennessee Copper Co., Ducktown, Tenn.; the Cornwall mine, of Bethlehem Steel Co., in Lebabon County, Pa., and Fontana copper mine in Swain County, N. C.

States contributing to the lead and zinc output in the Eastern group were: New Jersey, New York, Tennessee, and Virginia. A small tonnage of lead ore was mined in Tennessee.

TECHNOLOGY MARCHES ON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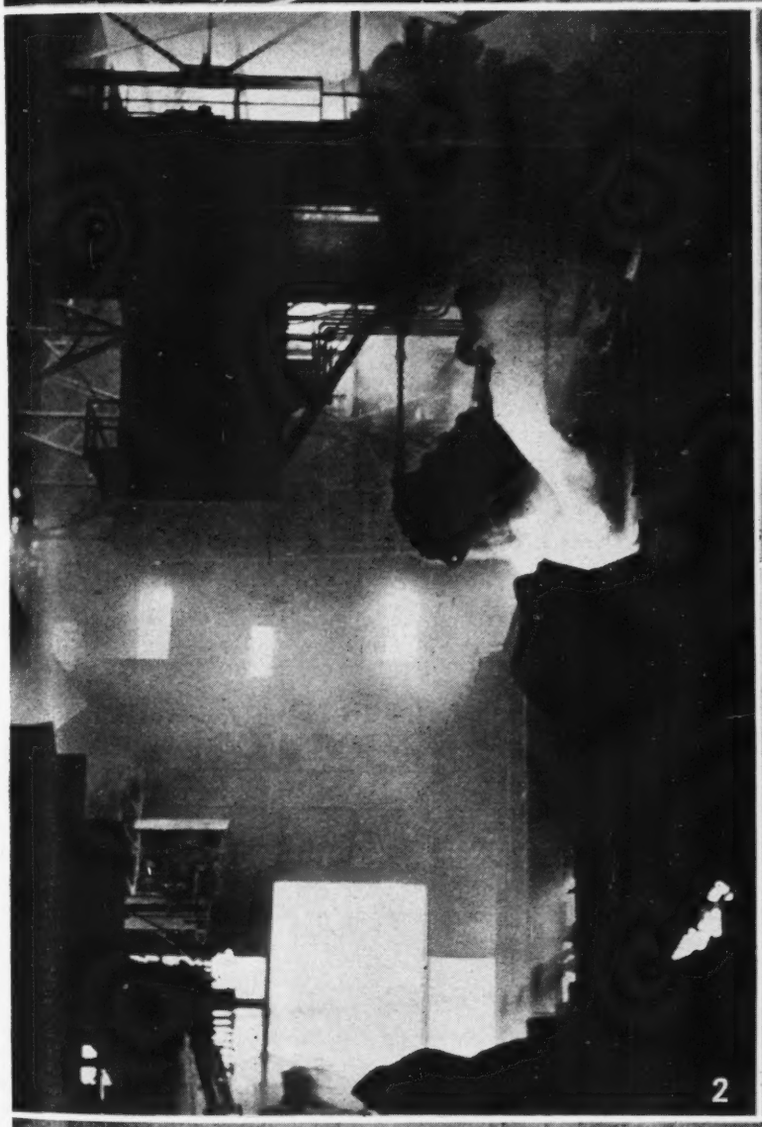
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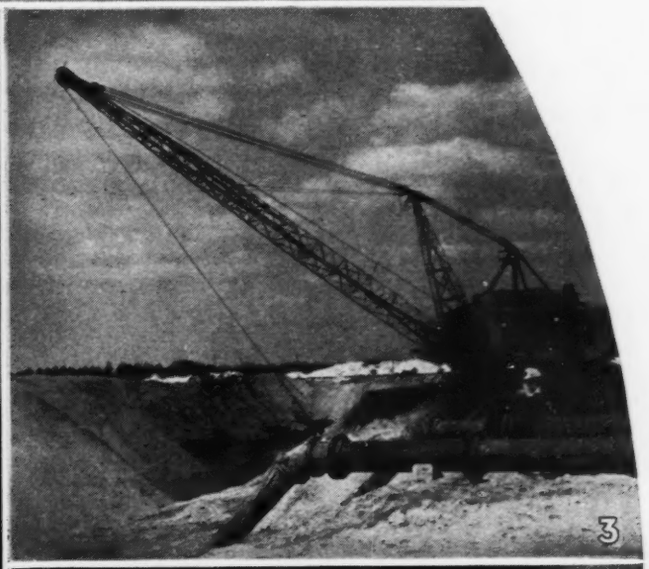
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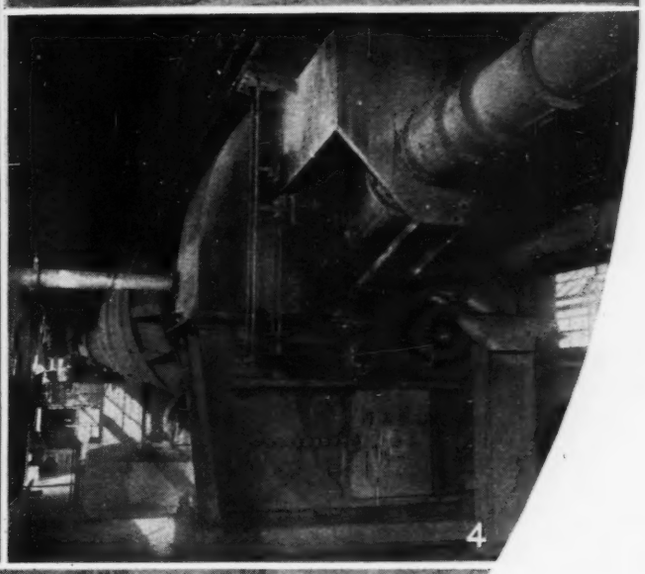
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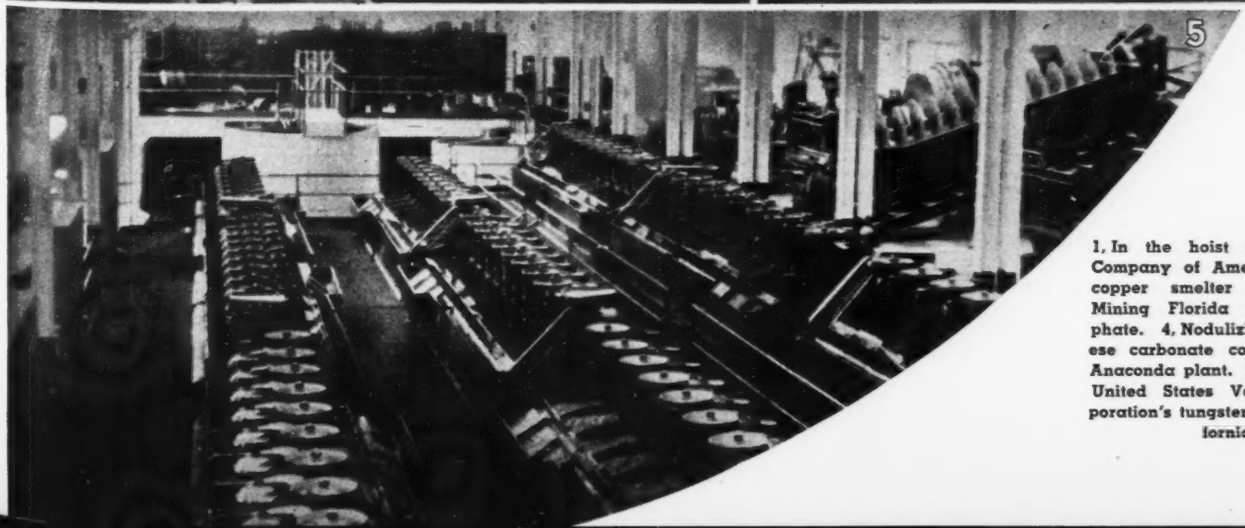
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1, In the hoist room, Potash Company of America. 2, At a copper smelter in Peru. 3, Mining Florida pebble phosphate. 4, Nodulizing manganese carbonate concentrates in Anaconda plant. 5, Flotation in United States Vanadium Corporation's tungsten mill, in California

Mining Technology

Shuttle car haulage finds application. More exact information desirable on ground support and subsidence. Avoidance of dilution

Robert S. Lewis
University of Utah
Salt Lake City, Utah

THE QUESTIONS of ground support and of subsidence are of prime importance as mining is carried to greater depths. Two adjacent stopes with a pillar between are like two arches. If the intermediate pillar is removed and the two stopes are merged into one, greater weight is thrown on the two outside pillars. Anticipating increased pressure at certain points because of removing intermediate support has proved of marked value in block caving. Stress patterns from studies in photo-elasticity are clarifying our knowledge of the points at which maximum stresses are to be expected. A study of detecting audible noises, with geophones in drill holes, as a sign of impending rock-bursts in deep mines is under way. It has been learned that on a day on which rock-bursts occur there is an increase of from ten to twenty times the normal disturbances or cracking of the wall rock.

Because of dilution from weak walls many mines have changed from open stoping or shrinkage stoping to cut-and-fill. Square-set stoping has also been so replaced, because of high timber consumption and low unit production. To offset the danger of dilution rapid extraction and quick filling is necessary. An increased stoping rate was made possible by revising the cycles of drilling, scraping, and filling, but a "bottleneck" was discovered in some mines in the rate of filling, as this had to be done more quickly than heretofore. In one operation a new waste-transfer system was devised, using 4-ft. Calyx drill holes between levels 200 ft. apart, with pockets, and also through connections to the levels below at each level. At the bottom of the pass system is a skip pocket. Waste can be drawn off for filling on each level or it can be passed down to the pocket, hoisted, and dropped to any desired level, where it can be drawn off in 53-cu.ft. Granby cars.

In block-caving, experiments with shaking conveyors indicate that handling sticky or wet ore gives rise to serious problems. Use of scrapers where the lift of ore is not high enough to warrant full development by branch raises makes it possible to extract the ore at reasonable cost, though trouble with one finger, especially the first, may stop production from the others in the "slusher" drift. Blocks of ore, where the height varies greatly over the block, are now undercut and drawn in such a way that dilution is held under control. Consideration is being given to possible use of a conveyor underneath grizzlies, where the ground around the grizzly sets stands well. Control of drawing would be easy.

Large blasts underground shake the ground, and under some conditions may intensify the problem of support. By use of long diamond-drill holes and blasting in vertical slabs the ground is less heavily shaken and ore can be broken at a low cost. Soft copper ore has been mined by modified top-slicing. Square blocks were laid out and mined by raising in the center of the block and sloping the floor of each slice toward the raise from all four sides at about 15 deg. Steel plates are laid for the ore to slide on.

In mining non-metallics by shrinkage below some 350 ft. of alluvium cover it is necessary to fill. By putting down 8-in. churn-drill holes into the top of mined-out stopes, and reaming to 10 in., filling can be dropped directly into the stopes. Only occasional holes require casing. A grizzly with 4x6-in. openings is placed over each hole. The fill spreads out in cone-shaped piles. To take care of the empty space between the cones a steel slide is set up below the hole.

Mitchell top-slicing has been modified in its application to vertical and horizontal pillars. High lifts are divided into sublifts of 50-ft. maximum height. A scraper pulls the ore, as it falls down the lead set, into an extraction drift at right angles to the sets. Another scraper in the drift pulls the ore to chutes leading to the main level below. Where there are not too many lead sets on a side, the broken ore will pile up in the lead sets until it runs by gravity into the extraction drift.

Calyx drill holes up to 400 ft. deep are used as winzes or as pilot holes for driving winzes and shafts. Holes over 100 ft. deep have, at one property, proved cheaper than the average raise. Old timbered raises in filled stopes have been converted into fill raises by placing a circular chute of ½-in. plate inside the cribbing. The 6-ft. steel sections are butt-welded and placed in position with wood blocking and then fine waste is run in around the chute. At one mine where the walls of large drifts are good but the back needs to be lagged off for protection 10x10-in. caps are placed on steel pins, two 1½-in. pins at each end. The lagging is laid on the caps. The pins hold well, save the cost of posts, and the drift is wider in net working space.

The new self-contained gold dredge fitted with a single bucket mounted on the digging boom, and operating much like a power shovel, has proved satisfactory, though limited to a digging depth of about 25 ft. Both dragline and bucket-elevator dredges are aided by greater use of auxiliary excavating equipment. Overburden has been stripped by bulldozers almost to full depth, so that a bucket dredge can dig to the pay gravel. Gravel in a stream higher than the main stream, like a hanging valley, has been stripped and then excavated, transported, and dumped by carryalls in the path of the dredge working on the main stream. "Doodlebug" dredges now have capacities practically equal to those of bucket dredges—i.e., up to 10,000 cu.yd. or more per day. A successful dry washing plant uses a ¾-cu.yd. dragline, of 100 to 125 cu.yd. per hour capacity, to excavate and deliver the gravel to the screening and disintegrating plant. Tables, given 3,600 impulses of low-pressure air per minute in combination with mechanical vibration, recover about 1 cu.yd. of concentrates from 30,000 cu.yd. of gravel.

In an underground non-metallic mine an electric shovel with 1¼-cu.yd. dipper handles 700 tons per day. Rooms are 12 to 14 ft. high and the shovel clears the roof by inches. Cars of 36-cu.yd. capacity (42 tons gross) are being replaced with 50-cu.yd. cars. Where power shovels on surface give trouble in winter from the dipper handle

breaking and material freezing inside the dipper, electric resistance heaters have been used on the dipper handle and the outside of the dipper plates. Thermostats cut off the current at 25 deg. F. At one property it was found economical to replace hand shoveling for unloading concentrates with a tractor shovel on 56-in. gage caterpillar treads. The shovel, having a ¼-cu.yd. dipper, 12-ft. boom, and 10-ft. dipper stick, runs up a ramp into the open end of a gondola. It is held stationary by steel cables, and by running the tractive drive the car is moved under it. Thus the shovel unloads and acts as switch engine.

Underground Loading

Mechanical loaders are being improved. One type is provided with a short conveyor loader at the rear for loading larger, higher cars (15 ft. long and 6 high). One company had to change to a larger mechanical loader when it was found desirable to replace 65-cu.ft. cars with 102-cu.ft. cars.) The conveyor has its own drive and speed regulation, controlled by the loader operator from his normal position. The loader can be dumped in any position, as the wide hopper of the conveyor will catch the dipper discharge. For loading gondolas from stockpiles, a 3½-cu.yd. specially shaped dipper has been mounted on a caterpillar tractor. The tractor shuttles back and forth between car and stockpile, the dipper being swung up over the tractor on curved guides to dump automatically from its back into the car. About 337 long tons have been loaded per hour. Another excavator combines loading and bulldozing in that the dipper can be held at ground level like a bulldozer or lifted vertically as a shovel.

Drilling blast holes subjects the drill to heavy shocks. Improved drills have larger diameter and shorter shafts fitted with ball or roller bearings. Power is transmitted through a shock-absorbing multicord belt. Mast-head shock absorbers have been strengthened and have been equipped with hydraulic recoil cylinders. The derrick can be used at full height or telescoped one-third.

At one open pit 125-ton combination battery-trolley locomotives are used for main-line haulage. By not using a trolley wire on the benches, 43 percent in overhead was saved for the mine as a whole. Each locomotive hauls a loaded train of 12 130-ton cars 4,000 ft. in 6½ min. The batteries are recharged on the main-line haul, which is downgrade, at a voltage ranging from 630 to 890. Each locomotive has four 380-hp., 750-v. motors. Dynamic braking is used on the 4 percent grade. Speed is closely regulated through 22 controller notches. At another open pit heavy trucks were found more economical for stripping, though the pit was developed for rail haulage. By heading the shovel into the bank at 45 deg., a truck could be loaded on each side with only a 90 deg. swing. Shovel capacity was increased 500 tons per shift. Use of trucks made it possible, on making a new cut 40 ft. deep, to dig down on a uniform grade of 2 percent. If locomotive haulage had been used four separate cuts 10 ft. deep would have been required. In the hot, desert climate diesel trucks gave about 27.5 ton-miles per gallon of fuel—practically double that of gasoline trucks.

Diesel locomotives have been successfully used in large tunnels, the gases being passed through washing tanks and through a labyrinth to hold back sparks. Before discharging gases into the atmosphere they are diluted with air at the rate of 2,500-f.p.m. This practice reduces the carbon monoxide to 0.002 percent.

On large mine locomotives hydraulic brakes have proved quick-acting and effective even on adverse grades. The shoes are actuated by oil kept under pressure by pump and accumulator. The usual method of "bucking" or "plugging" motors to aid the hand brake is hard on electrical equipment.

Shuttle cars are operating successfully in certain mines. These self-contained means of trackless haulage may be operated by storage batteries, by diesel engines, from cables or reels, or from a double trolley wire. If fitted with a bottom conveyor, they can load from or discharge at a single point. They can run on grades up to 10 percent, but are best adapted for flat beds. Narrowest working for them is about 8 ft. wide; economic length of haul 800 ft., and capacity up to around 10 tons. They are well suited to handling fill as well as ore, and can discharge directly into a winze. At a lead-zinc mine 6-ton shuttle cars are loaded by slushers mounted on caterpillar treads.

Shafts and equipment are standardized as to size in one foreign district. Thus equipment can be moved from one shaft to another. Large companies having several shafts might profit thus. At one shaft sinking was facilitated by using a crosshead and platform in the large supply-cage compartment. The platform carried a 16-outlet manifold for air and a 14-outlet manifold for water; 75-ft. lengths of 1-in. air hose and ½-in. water hose were hung from the platform, which was lowered to the desired distance above the bottom by a surface hoist.

More attention is given to coordinating drilling and blasting as the two main factors affecting excavation cost. They should not be considered separate and independent. Efficient charging and stemming should follow proper placing and bottoming of holes to secure maximum economy. Holes should be bottomed in the same vertical plane (i.e., for drifts) and overdrilling should be avoided. An improved crimper makes two continuous beads on the inside of the cap, which grip the fuse tightly enough to make the connection watertight without waterproofing compound. A fuse cutter insures that the fuse will be cut off squarely.

The trend in drill steel is toward the use of smaller-diameter steel and bits. In one operation 1-in. quarter-octagon steel was replaced by ⅞-in. quarter-octagon. Although with larger starters more regrinds per bit can be had than with smaller ones, the use of smaller bits results in a higher drilling rate, less steel, breakage, and smaller machine-maintenance cost. Jumbos are increasingly used for mounting machines. One type takes one to three drills which can be placed quickly in proper position. It can be mounted on a mine car. It saves time and makes less work.

Vertical turbine pumps now have efficiencies as high as 90 percent due to a new type of diffuser vane. By giving the blades a rounded or bulbous edge, the water always meets the edge of the vanes at the same angle, even though pump capacity is varied by throttling the discharge pipe.

A new light diamond drill can be mounted on a column and operated much like a machine drill. The trend here is toward increasing rotation speed and decreasing the pressure on the bits to secure faster drilling at a low cost.

Ventilation and air conditioning are getting much attention. Portable conditioning units can be used to advantage in development headings, where cold water is available. One type has a spray and baffle-plate for removing dust and a contact heat absorber for cooling the air. Water can be piped to it (and back) from a higher level. Another type of conditioner requires a pump to supply water and the exit water drains out on the same level

Filtering Tunnel Air

At the Carlton tunnel, at Cripple Creek it was found that air containing large volumes of powder smoke, in which the monoxide content was as high as 0.15 percent, could be passed through an activated charcoal filter and the monoxide reduced to 0.01 percent. Where the rock temperature on the lowest level is 150 deg. F., a mining company has installed several underground refrigerating machines for cooling the air. It is expected that the air temperature can be reduced to approximately 90 deg. F. Total refrigerating effect of all machines in use is equivalent to the melting of 1,680,000 lb. of ice underground per day.

Various items contribute toward more efficient operation. Use of galvanized iron pipe for air and water lines results in less pitting and corrosion. Either the common type of

fluid drive or the variable-speed fluid coupling serve to eliminate shock and protect motors and machinery from overloads. Fans, locomotives, dredges, and power shovels have been fitted with these drives to good advantage. Air pipes up to 8 in. in diameter have been bent by filling them with sand, heating, and then bending. By using a blow torch and heating the pipe on one side at spots, the pipe can be bent by making wrinkles in it. The method is simple and causes little constriction in the cross-section. Deposits and incrustations in various kinds of pipe can be removed by a new cleaning method. A rubber ball covered with a chain mesh is forced through the pipe along with the fluid being pumped. By first inflating the ball with air and later filling it partly full of water the ball is made to scrape against the top of the pipe and then the bottom. Several passes may be required to clean badly incrusted pipes. Rubber-cushioned self-centering car couplings make it easy to couple cars automatically though the couplings are out of line. They eliminate slack between cars and allow cars to be emptied in rotary dumps. Underground toilets connected to septic tanks make for improved sanitary conditions underground and eliminate unpleasant labor. Regular toilets are used in some mines where the ground stands well, the toilets being piped to septic tanks on a lower level. The tank effluent passes into the drainage system and should not have an offensive odor.

Ignitron mercury-arc rectifiers are being used in increasing numbers underground, where the desired d.c. voltage may be as low as 275. However, a power contract may place a premium on using a motor-generator set to correct the power factor.

Mine buildings have been built without windows. With such a design tight walls are easily constructed, uniform lighting is always had inside, and walls are smooth and have no window sills or frames to act as dust collectors.

Greater attention is being paid to the health of employees. At several mines the men are given a treatment with "sun lamps." One industrial company cut down absenteeism from colds during the winter by giving its men one capsule of vitamins every morning. The capsule contained: 10,000 units of vitamin A: 1,000 units of vitamin D; 500 units of B_1; 500 units of C; 1,000 units of B_2; 200 units of B_6; 500 units of pantothenic acid and 20 m.m. of nicotinic acid. Such treatment might be more economical than installing a solarium. A new ear plug is said to reduce loud noises to one tenth of their actual value and yet permit the hearing of conversation. Thus the worker can concentrate on his job with greater efficiency.

Mining Geology

Field methods appear to be little changed. Some contributions to the literature of the year are examined.

Harrison Schmitt
Mining Geologist
Silver City, N. M.

STEADY PROGRESS in the science of ore deposits was recorded in 1941. The quantity of geological work authorized and done appears to have increased parallel with improvement in the quality of the work and techniques used. Below are discussed papers and books published during the year which have been available and which I think are critical.

The paper by C. P. Ross, "The Quicksilver Deposits of the Terlingua Region, Texas," *Ec. Geol.*, Vol. 36, pp. 115-142, 1941, is of particular interest because it is possibly the first modern study of a mining district which assigns an important rôle to meteoric water in hypogene ore deposition. Few would deny that the genesis of most quicksilver deposits is related to hot-spring activity. Day[1] and others have shown that meteoric water dominates in hot-spring discharge. Many think that mercury deposits and epithermal gold-silver deposits are closely related in origin. See, for example, Fraser[2]. Consequently, it is not radical to consider meteoric water an important factor in the genesis of epithermal ore deposits. So far not satisfactorily explained is the common occurrence of epithermal oreshoots in a vertically t bular ribbon-like zone contained in a lode, but with the top and bottom subparallel to the surface of the present day.

This surface can often be shown to be not far below the earth's surface at the time of origin. Are not these subhorizontal boundaries likely to be related genetically to a thick horizontal blanket or zone of meteoric water at the time of origin? Assumption of such a blanket may explain the intricate mingling of hypogene and supergene mineralization phenomena, and, further, suggests that there may be a fundamental unconformity between the genesis of epithermal veins and the hypothermal and possibly the mesothermal veins. On the other hand, if epithermal, mesothermal, and hypothermal veins are all intimately related, it is not hard to believe that meteoric water may affect precipitation at least in shallow depth examples of all these classes. Numerous authors have suggested that many of the higher-temperature deposits were formed near the original surface.

"Host-rock Inflation by Veins and Dikes at Grass Valley, Calif.," by R. Farmin, *Ec. Geol.*, Vol. 36, pp. 143-174, 1941, is a scholarly exposition of the thesis of ore magma intrusion. We have here a resurgence of Spurr's ideas. The author's abstract follows:

"Structural deformation of the rocks of the western Sierra Nevada has developed zones of faulting and of minor partings that are only slightly dilatant, appropriate in deep-seated environment. Gold-quartz veins and dikes of igneous rocks contain inclusion breccias and occupy partings of highly dilatant character-features that may result from the inflation of deep-seated rocks by an injected fluid but would only be associated with near-surface fault fissures. The folding of inter-vein and inter-dike wall rock during inflation of the partings is discordant with an open-fissure environment. Most of the structures found in the gold-quartz veins are likewise found in igneous dikes of comparable size—parallel mechanisms of emplacement are indicated."

This paper will create serious discussion. It may be suggested that the dynamics during the period of quartz formation following an admittedly early period of only slightly dilatant high-angle reversed faulting may have

[1] Day, A. L.: "The Hot Spring Problem," G.S.A. *Bull.*, Vol. 50, pp. 317-336, 1939.
[2] Fraser, H. J.: *Ec. Geol.* (Abs.), Vol. 34, p. 468, 1939.

been regionally permissive in character rather than locally persuasive. The quartz may have been progressively deposited as openings were made available by regional dilation. With this process the "strap" structures described by Farmin seemingly could be formed. He admits that he cannot visualize the character of a magma necessary to cause the effects he describes. The veins are largely quartz. He suggests a magma of 10 to 40 percent SiO_2 the remainder CO_2, and presumably water. Would not such a magma shrink on emplacement and would not shrinkage leave significant structures? The author's explanation of wall-rock effects may not be satisfactory from a quantitative basis. These effects, according to him, were possibly caused by a fraction from the ore magma. After careful studies of the wall-rock alteration on the Mother Lode, Knopf[3] believes that "Enormous quantities of silica have liberated . . . and carried out . . ." A quartzoid ore magma is not likely to *remove* quartz from the wall; for that matter, neither is a silica-charged slow-moving fluid. Knopf thinks the vein quartz may have come from the walls.

W. H. Newhouse's paper, "The Direction of Flow of Mineralizing Solutions," *Ec. Geol.*, Vol. 36, pp. 612-629, 1941, is probably a fundamental contribution and should be useful in exploration. The author's abstract follows:

"In a moving solution a crystal grows most rapidly on the side that faces the direction of flow. This is because nutrient material is carried to it on this side by bodily movement of solution, and also by diffusion, while on the lee side of the crystal the nutrient material is carried in large part only by diffusion. Thus, the direction of solution movement can often be determined by examination of the growth zones in minerals. This is usually done by sectioning the minerals. Lineages where present may also be used to determine the preferred growth direction. Crystal distortion may also be used. Overgrowths of crusts or scattered small crystals resting on an earlier crystal or other object also afford good evidence. Preferred corrosion or solution of a mineral or mineral aggregate is analogous. The vectorial properties of crystals interfere to some extent.

"These features have been studied on crystals formed in the laboratory and on many minerals and ores. The experimental work and several examples of ores and minerals are briefly described."

In the experimental field Newhouse has made at least two other apparently valuable contributions to the science of ore deposits; the determination of the character of the liquid inclusions in sulphides and the determination of temperature of formation by the study of gas bubbles in liquid inclusions in crystals.

C. H. White has written a paper on "A theory for the concentration and distribution of copper in the earth's crust," *Ec. Geol.*, Vol. 36, pp. 1-18, 1941. His abstract follows:

"Copper occurs in traces, if not in determinable amounts, apparently, throughout the entire crust of the earth; but commercial deposits, although found in every type of rock, occur only where the crust has been fractured, fissured, or sheared. As the earth cooled to temperatures permitting chemical union of the atoms, the interaction of physical and chemical forces, notably gravity and combination of the elements in the order of the heats of formation of their compounds, depressed the major parts of copper, sulphur, and other of the less chemically active heavy metals and their associated anions to a zone below the silicates where they remained until released through fractures in the solid crust."

This paper, which perhaps should be called a hypothesis on the origin and deposition of copper deposits, contains speculative material that will arouse dispute. By unusual and independent premises, however, several conclusions are derived that in recent years have gained adherents. These are that cross-cutting earth structures may be more immediately critical in the origin of ores than associated intrusives and that the most common gangue mineral, quartz, may be derived by alteration processes. One wonders why currently in the United States the broad speculative considerations on ore genesis get proportionately much attention from men commercially applying mining geology such as White, Locke, Billingsley, Spurr, Wisser, Mayo, and others, and less from the teachers of geology.

Work on Pegmatites

Currently much work is being done on pegmatites. Papers by D. J. Fisher, "Pegmatites Near Custer, South Dakota" (Abs.), and K. K. Landes, "Paragenesis of the McDonald pegmatite near Hybla, Ont." (Abs.), both in *Am. Mineral.*, program and abstracts, Dec. 1941, and one by W. D. Michell, "Paragenesis of the Pegmatite Minerals of Striegau, Silesia," *Am. Mineral.*, Vol. 26, pp. 262-275, 1941, show closely similar paragenesis. What the authors call a magmatic stage is followed by stages of replacement the first of which is albitization. May one suggest caution in accepting even the first stage as magmatic because it is clear that some aplites, which admittedly are closely related to pegmatites in origin, for they often occur in the same "dike," are replacements. A narrow aplite dike at Hanover, New Mexico, well within a granodiorite intrusive shows throughout ghost fabric of the granodiorite. A. Locke tells of aplites of similar characteristics and E. G. Goodspeed and R. E. Fuller, in "Replacement Aplite Breccia" (Abs.), G. S. A. Bull., Vol. 52, abstracts, p. 1805, 1941, describe aplitic material replacing a host.

Modern studies of deposits of metals in igneous rocks, the so-called magmatic segregations, often conclude that the metals are epigenetic replacements, not syngenetic segregations. See, for example, a recent abstract of a paper by E. N. Cameron, "Origin of Sulphides in the Nickel Deposits of Mount Prospect, Connecticut," G. S. A. Bulletin, Vol. 52, abstracts, pp. 1891-92, 1941.

F. F. Grout in a thorough and competent paper, "Formation of Igneous-looking Rocks by Metasomatism; a Critical Review and Suggested Research," G. S. A. Bull., Vol. 52, pp. 1525-1576, 1941, frowns on uncritical enthusiasm for the hypothesis for the formation of "igneous" rocks by replacement. We shall not progress unless occasionally someone is willing to propose and test new hypotheses.

W. C. Krumbein's paper, "Influence of Geophysics and Geochemistry on the Professional Training of Geologists," A.I.M.E., T. P. 1327, 1941, is a carefully thought out analysis of the interrelationships of geology and other sciences and emphasizes the need for more basic science training in geology. To some of us in professional mining work it is interesting to see the teaching profession just now discovering the need for this. In mining, at least, it has been recognized for years that the proper base for geology is mining engineering with advanced and graduate work in geology. Today we reluctantly accept, if we employ at all, recent graduates in geology lacking basic training in engineering or equivalent science. To succeed such graduates must overcome severe obstacles and competition.

W. H. Emmons' new edition of "Principles of Economic Geology," McGraw-Hill Book Co., Inc., New York, N. Y., 1940, is a fine book and will be widely read. It has been reviewed by C. Behre, Jr., *Ec. Geol.*, Vol. 36, pp. 101-103. Like Behre, however, one is surprised at the absence of material on the techniques of application such as mapping, etc., in books of this kind.

The Geological Society of America has just published a 50th anniversary volume which reviews geology from 1888 to 1938. Written by outstanding experts, it is fascinating. All professional geologists should read it.

The U. S. Geological Survey continues to publish bulletins on strategic minerals. These are unique in being essentially appraisals using high-grade geology as well as submitting ore estimates. They set a high standard in appraisal.

Applied geophysics in petroleum exploration may now have taken the cream from potential discoveries in the United States amenable to the new techniques. The success of these methods

[3] Knopf, A.: "The Mother Lode System of California." U. S. Geol. Survey, P.P. 157, p. 45, 1929.

has been great, but doubtfully justifies the thinly veiled contempt of professional geophysicists for the petroleum geologist trained essentially in "observational" geology. The pendulum will swing back. Cooperation between geophysicists and "conventional" geologists will give a maximum of success. In mining exploration applied geophysics in the current sense—i.e., the electrical methods—has had a very limited success and to date has largely failed when the value of the results compared with the expenditures is considered. Applied geophysics in the broader sense as noted in earlier paragraphs using such tools as the spectograph, etc., is being more and more experimented with and in time should greatly aid ore finding. The electrical methods in the hands of geophysical experts willing to cooperate with expert professional geologists should be of help in special problems.

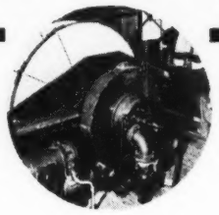
At the engineers' meeting in New York, February, 1941, the professional geophysicists clearly showed that they felt competent to absorb professional geology as now organized. The most charitable thing that can be said is that their attitude is the result of misinformation on mining geology. Many have observed, however, that exceptional ability in mathematics and physics does not necessarily make a good geologist.

The increasing use of precision instruments in the study of ore deposits is illustrated by several papers.

There seems to have been little change in field methods, although improvements have been long overdue. Topographic maps on large scales made by means of airplane photography (photogrammetric maps) may be a step in the right direction, particularly where areas of more than a square mile or so are surveyed. Such maps by a well-known firm on scales of 1 in. to 200 ft. can be made almost as accurately as plane-table maps. By using them with a plane table and alidade much time can be saved in geologic mapping, as the whole effort can be concentrated on locating geological observations and none is wasted on points for topography. These maps are well suited, also, for direct sketching of geology because intricate details of topography can be shown. The companies which make them will establish a permanent triangulation net, true meridian, elevation and geographic location by theodolite with an adequately small limit of error. Where more than several square miles are surveyed the cost in rugged country is less than it would be by standard topographic methods.

Journals consulted for this review include: *American Mineralogist, Bulletin of Geological Society of America, Economic Geology, Engineering and Mining Journal, Journal of Geology, Mining and Metallurgy, Science.*

Mineral Dressing



Beneficiation of essential minerals gets attention. Sink-and-float process further applied. Non-sulphide flotation expands

S. R. B. Cooke
Montana School of Mines
Butte, Mont.

DEVELOPMENT and application of old and new methods of beneficiation of strategic and essential minerals has been the keynote of the year. Leading in this work, and ably supplemented by private and institutional laboratories, is the U. S. Bureau of Mines. Emphasis has been placed on the development of the newer processes of sink-and-float concentration, and of flotation of non-sulphide minerals (particularly with cationic reagents), but the older and established ore-dressing processes are also receiving attention for treating refractory and low-grade ores.

The Bureau's research laboratories have been enlarged for research in ore testing and for investigating more fundamental phases of mineral dressing. Two manganese pilot mills are being operated by the Bureau. The Tuscaloosa, Salt Lake City, and Rolla stations are now adequately equipped for microscopic, chemical, spectrographic, and X-ray investigations of ores.

Sink-and-float treatment is firmly established as a preconcentration step, and in some cases as the final stage of concentration. Following its applications to sulphide and to iron ores, we now hear of its use in the non-metallic field.

Non-sulphide flotation, having earned its laurels in the laboratory, is rapidly expanding. Mills started in 1941 include those floating rhodochrosite, graphite, cement-rock, barite, sulphur, coal, magnesite, zircon, and vanadium and titanium minerals.

In mineral-dressing education there is a definite drift away from the old routine teaching of ore dressing, and a healthier insistence upon comprehension of fundamentals. Contributing largely are Taggart's advocacy of a more comprehensive curriculum in mineral dressing and Gaudin's relatively new textbook, "Principles of Mineral Dressing." It is a truism that the ore-dressing engineer leans heavily on the tools of the mineralogist, physical and organic chemists, and physicist.

COMMINUTION — Design of comminuting machinery continues to improve, although no radical changes are evident. The Traylor-Stearns Multi-Stage crusher, delivering large tonnages of material minus 9/16-in. or finer in size, has proved its value. The Butler Rocker mill has been installed for fine crushing in a large Tri-State zinc-lead mill, but performance data are not yet available. Improved lubrication and more specialized applications of alloy steels in breaking parts are noted. There seems to be a growing tendency toward providing finer feeds for ball mills, although this is not a generally accepted idea.

Sink-and-float concentration is attracting increasing attention. It requires an ore product containing a minimum of fines, which will influence the design and choice of crushing equipment.

There is a tendency to introduce larger ball mills to reduce the number of operating units. Consonant with this, but just now limited by the lack of material, is the increase in mill volume and capacity gained by using thin liners of special alloy steels. In particular may be mentioned the use of Ni-hard liners and grinding media, with a greatly increased life for these parts.

A trend also exists toward elimination of scoop feeding of dilute feeds to rod and ball mills and using individual hoppers above the mills, connected to the latter by slip joints. Maximum circulating loads have been stabilized

between 400 and 600 percent, and except in special cases this seems to be an economic limit. Current difficulties have eliminated Danish pebbles as media for special grinding problems, as in ceramics. Steel and iron balls and Newfoundland pebbles provide a poor second-best.

Explosive shattering is to be used at the new manganese pilot plant of the U. S. Bureau of Mines in South Dakota. This method of comminution is said to give excellent mechanical separation of the manganese nodules from the associated shale and bentonite.

Research continues in comminution fundamentals. With the death and burial of the Kick postulate, the Rittinger law holds the field, and investigators have turned to methods of determining surface area from size distribution. Schumann and Bond have provided thought-provoking papers in this field but much more work is needed.

Taggart has introduced two useful terms in rating relative capacities and efficiencies of primary and intermediate crushers. These are respectively "reduction tons per hour" and "reduction tons per horsepower-hour." These new units place proper emphasis on crusher setting, lithological character of feed, maximum feed size, fines in the feed, its moisture content, and method of feeding, most of which previously have been ignored in comparing capacities and efficiencies.

The Lake Shore Mines staff, in a paper remarkable for scope and amount of work indicated, have substantiated, under operating conditions, the findings of Coghill and his coworkers that the capacities, horsepower, ball-wear, and liner-wear vary as the 2.6 power of the mill diameters.

SIZING—Screening has been applied to manganese ore in an unusual manner in the Bureau's South Dakota pilot mill. The ore, consisting of nodules associated with shale and bentonite, is crushed to 6 in., partly kiln-dried, and then screened on a double-deck screen. Oversize from the coarse 1-in. screen is a finished product, the undersize is waste, and the intermediate size is further concentrated by washing.

Mechanical efficiency of classifier has been improved. A radically new design operating on hindered-settling principles is being tested. Performance data are not yet available.

In many operations, use of classifiers operating in closed circuit with grinding machines leads to deleterious overgrinding of heavy economic minerals. Greater attention is being paid to the possibility of using screens for removing fine-sized material and reducing this overgrinding. Use of stainless-steel screens has facilitated utilizing closed-circuit grinding to 65 mesh. Screening to finer sizes is mechanically practicable, but has economic limitations due primarily to screen cost. The new powder metallurgy may lead to cheaper screens.

A recent development in classification, the use of centrifuges for making fine-size separations, is causing interest. In many instances the centrifuge can make a sharper split of subsieve sizes than is possible with a hydro-separator. A new cement-rock flotation plant uses a centrifuge to make a 20-micron split prior to flotation. The minus 20-micron size is treated by flotation and the concentrate combined with the plus-20-micron material.

Advantages of hydraulic classification prior to table concentration seem to be unknown to operators of many small mills. It is hoped that its widespread use in new non-metallic mills will have its effect in educating these operators.

FLOTATION AND AGGLOMERATION—Improvements in separation and operation continue in sulphide flotation, although without basic developments. Molybdenite is being separated from copper ores in several cases. There is nothing very new in sulphide flotation reagents. American Cyanamid has introduced Aerofloat 33, possessing somewhat greater promoter efficiency than Aerofloat 31, particularly with some silver ores.

As previously mentioned, the field of non-sulphide flotation has shown expansion. Thus the problem of providing adequate supplies of strategic minerals is answered in part.

Manganese ores from near Las Vegas, Nev., hitherto resistant to beneficiation, are being treated successfully in a U. S. Bureau of Mines pilot mill. A new cationic reagent, DLT-958, is used to float gangue minerals, leaving a product, which, when sintered, is suitable for making ferro.

Of particular interest is Anaconda's new 1,400-ton manganese flotation mill. The rhodochrosite ore, carrying 20 percent Mn, with quartz and sulphides, is ground to 65 percent minus 325 mesh. A bulk sulphide flotation concentrate is removed, the pulp conditioned with sodium silicate and soap, and a manganese rougher concentrate removed. The concentrate is cleaned in two stages, thickened, and fed to a rotary gas-fired kiln. The final black oxide contains 60 to 61 percent Mn with 6½ percent SiO_2 and less than 3 percent Fe.

Shelton and Fine report laboratory production of ferro-grade concentrate from Cuyuna manganiferous iron ores by a combination of jigging, fine-grinding, bulk flotation of iron and manganese oxides, reduction-roasting of the flotation concentrate, and magnetic separation.

An unusual combination of flotation and chemical treatment is used at the U. S. Vanadium Corp.'s new mill in California. Sulphide reagents are steamed out of the pulp after removing a bulk sulphide concentrate containing molybdenum. Cresylic acid, an Emulsol reagent, and sodium oleate are used to float a scheelite concentrate, which is treated in autoclaves with steam and sodium carbonate. The soluble sodium tungstate thus produced is removed and reprecipitated as a nearly pure artificial calcium tungstate.

Success has been obtained by Clemmer, Clemmons and Stacy, at the Bureau's Tuscaloosa station, in beneficiating impure and submarginal bauxites by flotation, using both anionic and cationic reagents.

Flotation is being used as a primary recovery process in a growing number of fluorspar plants. Ten fluorspar flotation plants are reported in the United States alone. Fluorspar flotation concentrates are too fine to be used directly for flux in the basic open-hearth process, but recent patents assigned to the Mahoning Mining Co. cover their briquetting for this purpose.

The Southern Phosphate Corporation has placed in operation in the pebble field, a 700-ton mill to recover fine phosphate from old pebble phosphate washery dumps. Screening, hydraulic classification, agglomeration, and tabling are used to give an estimated 90 percent phosphate recovery.

Important contributions to the neglected field of flotation machine design are given in a recent article by Malozemoff and Ramsey. Performance is discussed from the aspects of aëration, agitation, air distribution, pulp circulation, and mechanical design.

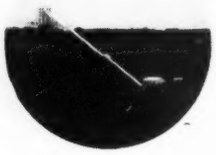
Publications in fundamental flotation theory have been scarce, probably due to diversion of effort to the defense program. Added support to the chemical theory is contributed by Knoll and Baker, who found that clean galena, in the absence of oxygen, does not remove xanthate ion from solution, and that "clean" galena possesses no "inherent" flotability. On the other hand, Herd and Ure have found that a "cleaned" galena surface has a high degree of inherent floatability. Further, that "such a surface is rapidly oxidized by oxygen, and flotation recovery in the presence of xanthate ion is reduced to a low value." It is difficult to interpret these mutually incompatible results.

GRAVITY CONCENTRATION—Use of jigs for recovering fine, heavy-gravity material, including fine free gold, continues in favor, especially in California and Canadian gold mills. The new American-Granby mill of Federal Mining & Smelting Co. is using a 42x42 Nordberg-Wood chat jig in its flowsheet.

Southern Phosphate Co. has replaced the conventional table decks with masonite decks in its agglomerate tabling plant. Masonite is said to resist warping and oil, and oiled particles do not adhere to it.

Chromite deposits of south-central Montana have received attention. The U. S. Vanadium Corp. is building a

Iron-Ore Beneficiation



Lean ores play important part in providing additional tonnage needed for furnaces. New plants and flowsheets claim attention

Louis J. Erck
Assistant Metallurgist
Butler Brothers, Cooley, Minn.

MORE THAN 81,000,000 TONS of iron ore was shipped from the Lake Superior district during 1941. To meet the required tonnage for the coming year, mining and milling facilities will have to be increased. Old properties idle for many years are to be reopened and new properties will be stripped to increase production. The ore in many of these new areas is lean and will require beneficiation to make concentrates suitable for furnace requirements. Existing treatment plants are being repaired and at many properties are being remodeled or enlarged to increase the production rate. New plants also are being built in the iron district.

The large tonnages shipped during the past two years and the amount that will be required in the near future will tend partly to deplete the merchantable ore reserves. This will not only stimulate research work on new methods of concentrating lean ores, but will also bring about the investigation of new properties in the hope of adding to the reserves. New methods of beneficiation are being tried each year. Some have been proved satisfactory and are now being used; others are in the process of development.

At present, one of the larger mining companies is investigating the eastern Mesabi magnetic taconites. The area considered will be drilled systematically to outline the possible concentrating areas. This winter serious study will be given to the concentration problems presented by these magnetite-bearing taconites. In another case, an independent operator has opened an iron ore property on the southern Minnesota border. A simple washing plant is being built, and the concentrates will be shipped by rail to Southern furnaces.

A new method of concentrating lean-ore fines, replacing jigs and rheolaveur plants previously used, has been developed on the western Mesabi. The past season saw a commercial unit in operation, showing that it has a definite place. New plants are being provided on the Cuyuna and Mesabi ranges. At least one jig plant is under erection on the former to treat lean ore from an open-pit property abandoned for many years. The leaching plant proposed for treating the low-grade manganese ores of the Cuyuna has as yet not been finally decided upon. At the writing of this article no definite word can be given as to whether or not it will be built.

The Mesabi will be exceedingly active once the shipping season opens. Each organization is making sure that every means of concentrating ore will be at its maximum effectiveness. The western part of the range will be the scene of most of this activity, inasmuch as it contains the bulk of the low-grade

Mineral Dressing

(*Continued from page* 81)

200-ton mill in the State to treat the ore by gravity concentration and flotation. The mineral is a picotite and is amendable to gravity concentration. Rod-mill grinding will be used. Tests have indicated that a concentrate carrying 42 percent Cr_2O_3 and a 1: 1.8 iron to chromium ratio may be produced. Anaconda, under a management contract with the U. S. Government, is building a 600-ton mill to treat similar ore from the Benbow and Monat properties, on the Stillwater. Hydraulic classification and tabling will be used in the flowsheet.

The sink-and-float process is being diligently exploited. Evidence is shown by installation of pilot plants by American Cyanamid, University of Minnesota, and the Canadian Bureau of Mines. Bunker Hill and Sullivan, after much testwork, is adopting the H & H process to treat 1,400 tons of ore daily. This plant will eliminate at least one third-of the run-of-mine material, to the benefit of subsequent steps. In what is apparently the first application of sink-and-float in the non-metallic industry, the Barton Mines Corp. has placed in operation the North Creek plant, in New York. A separation is effected between industrial garnet and a hornblende gangue, using ferro-silicon as a medium.

For some time Eagle Picher's Central mill has treated minus-1½-in. plus-¾-in. heads by sink-and-float. This is soon to be tried out on plus-10-mesh material, with the possibility of extension to plus-20-mesh ore. R. E. Illidge states that instead of using the conventional cone there is a good chance for substitution in future installations of a tank like that of the Esperanza dewatering drag.

Tri-State milling is said to tend to the elimination of jigs and tables, with substitution of coarse and fine sink-and-float treatment. This would give a finished tailing and an enriched product for regrinding; this last, with primary fines, making flotation feed.

MISCELLANEOUS—Magnetic separators are being continually improved. The new Type K Crockett magnetic separator (Dings) treats magnetic material such as magnetite, ilmenite, and ferro-silicon to sizes as fine as minus 200 mesh, with reduced water consumption. The Dings-Rowand-Wetherill magnetic separator has new application in beneficiating American ilmenite.

A patent assigned to American Cyanamid covers the application of wetting agents in cyanidation as an aid to extraction.

The Hardinge "electric ear" and Masco "pulp-density controller" are finding increasing use for controlling grind. An interesting system of regulating flotation reagent addition automatically has been adopted at the mill of the Cuban Mining Co., in Oriente Province, Cuba. Non-sulphide reagents are added in direct proportion to the quantity of ore milled.

I wish to acknowledge my indebtedness to operators and millmen throughout the country and particularly to officials of the American Cyanamid Co., for so generously providing information pertinent to this article.

ores. Winter to date has been extremely favorable for the plant construction at hand. In some projects the work will be held up due to priorities and deliveries.

A plant similar to that put up in the 1940 season using Conset air jigs was constructed and operated in 1941. The flowsheets of the two are virtually the same. Middlings and tailings are ground to liberate the mineral and returned to the jig circuit. An outlet is provided in the closed circuit for the elimination of the jig tailings when the iron content is low enough to warrant discarding. The fines from the dewatering drags are thickened and also returned to the jig circuit. This plant is designed also for the straight washing of such ores as do not need complex concentration.

Another ferrosilicon sink-and-float plant is being built. In essentials it will be like the two now in operation. One cone will be used, as in the unit on the Cuyuna range. The feed will be approximately $1\frac{1}{2}$x$\frac{3}{16}$ in., and the undersize will be treated by the new process previously mentioned. The main plant now used for ordinary washing will prepare the feed for the cone unit on designated days and stockpile it in sufficient quantities to keep the "heavy-density" unit supplied. It is interesting to note that the ferrosilicon process is being used in other fields, as, for example, in New York to concentrate garnets for abrasives and in Bolivia for concentrating tin ores. Both of the new applications are for the scalping of lean tailings to reduce the amount of material to be crushed for further concentration.

It is possible that another jig plant will be built on the western Mesabi, at a property now equipped with a washer of the ordinary type.

Simplicity has been the keynote in designing the plants for the coming season, as in those recently constructed. Akins classifiers have been used in several of them for desliming screen undersize products in concentrating simple, straight wash ores. Last season four new plants using the simplified flowsheet were in operation. The results were so favorable that the several straight wash plants anticipated for the coming season will employ the same flowsheet. In the older ones where log washers and classifiers were used to concentrate the fines. Akins and heavy-duty Dorr FX classifiers have been installed to replace the logs and bowl classifiers.

Expensive mining equipment is being replaced in some operations as provision is made to transport crude ores from the pit to the plant direct by a conveyor system.

Such are the aspects of the situation in this time of need. Every effort is being put forth to assure the steel industry that the iron ore wanted will be supplied.

Copper Metallurgy

Pressure to turn out metal permits little time for plant improvements. Phelps Dodge builds smelter in Arizona. Hot-patching

Ettore A. Peretti
Assistant Professor of Metallurgy
Columbia University, New York

RELATIVELY few improvements can be recorded for pyrometallurgical copper plants during the past year. With the ever-growing needs of the military program, copper is now under strict priority control, and most producers are bending every effort to increase production to a maximum. Some producers' costs and metal losses have increased in attempting to achieve greater output.

According to Frederick Laist, construction of the new converter plant by the Anaconda company is nearing completion and it should be in operation early in 1942. The plant is adjacent to the existing reverberatory furnaces, so that the haul on matte and slag will be obviated. The Great Falls type of converter is being used at present, but the new installation will consist of four converters of the Peirce-Smith type. The plant has been designed by Wilbur Jurden, chief mechanical engineer for the Anaconda company, who is also in charge of the design and construction of the new Phelps Dodge plant in Arizona.

During the past few years there has been a more general use of the so-called "hot patching" of reverberatory furnaces. In this regard, Mr. Laist furnishes the following interesting comments: "Hot patching was first used in the latter part of 1927 for patching refining furnaces at the Raritan Copper Works, where it was developed by Mr. Ed Clark, the furnace foreman. The procedure was practically identical to that which was patented eight years later by Winkler and Kuzell. A finely ground slurry of silica, fireclay, and water was blown against the part of the furnace to be patched, by means of a cement gun. The Quigley gun was first used, but later a simpler type of pneumatic gun was developed by Mr. Clark. The procedure was submitted to one of the company's patent attorneys; but for some reason was declared unpatentable.

"Mr. W. T. Burns, who was then manager of the Raritan Copper Works, transmitted information concerning the patching process to the Anaconda company's refinery at Great Falls where it was put to use. At both plants the patching was done on the red hot surfaces of the refining furnaces immediately after the charge of copper had been cast and before the furnace was recharged with cold cathodes. Mr. Clark's hot patching process approximately doubled the life of the furnace walls.

"At the Clarkdale plant of the Phelps Dodge Copper Company, the process was applied successfully to the hot patching of reverberatory furnace roofs. The procedure was practically the same as that which has been in use at the Raritan Copper Works since 1927, although more care was taken in defining the technique. The publicity which this use of the process received resulted in its application at numerous other smelting plants. It is difficult to estimate the savings, which necessarily vary within wide limits. Where the furnaces are not overdriven and where the life of the surfaces exposed to the heat is long (say nine or ten months, sometimes a year) as at Anaconda, it does not pay to use hot patching. On the other hand, where the roof over the smelting zone burns out rapidly (possibly in three or four months) it does pay. The gain is by no means clear because of the frequency with which hot patching must be done (every day, sometimes every shift). Even though the work is done by the furnace crew, it entails a certain amount of labor. Moreover, the siliceous material blown

into the furnace has to be smelted."

According to W. A. Green and J. H. Ambrose, the Hudson Bay Mining & Smelting Co., at Flin Flon, Manitoba, has installed a holding vessel at the blister copper casting wheel. This vessel was part of the original smelter equipment, but was discarded early in 1931 soon after operations commenced, as the amount of copper produced at that time was insufficient to give satisfactory service. Since the vessel has been reinstalled it has operated most satisfactorily. It is a rotating cylindrical steel shell, 13 ft. in diameter and 20 ft. long, with unburned magnesite brick in the bottom and a 12-in. silica sprung arch. It is fired by pulverized coal, and the gases are vented to the atmosphere through a flue and stack.

Early in 1941 a new bin for converter flux was constructed outside the converter building. Flux is hauled to the smelter in 22½-cu. yd side-dump cars which dump directly into the new flux bin. Belt conveyors and a bucket elevator transport the flux to a smaller bin in the converter aisle.

Most of the mechanical difficulties attendant upon charging raw concentrates direct to converters have been overcome by first "pelletizing" the concentrates. This is accomplished by mixing them with a binder containing clay and starch, passing the mixture through a pug mill, and thence through a rotary kiln fired with pulverized coal.

J. C. Kinnear reports that the McGill smelting plant of the Nevada Consolidated Copper Corp. operated continuously during 1941. Blister production was greater than for any previous year.

No. 3 reverberatory furnace finished an operating campaign of 426.0 furnace-days at the end of July, and was shut down for extensive repairs to brickwork and steel at this time. This furnace has been in service, and has operated continuously except for short intervals during refractory repairs, since October, 1934.

In repairing the unit, the furnace outlet and uptake were reconstructed, effecting less resistance to the flow of gases from the furnace to the waste-heat boilers. The trend for the past several years at this plant has been to eliminate angles and turns in the furnace outlet and flue to the boilers, but the elimination of sharp angles and turns was carried out to a still greater degree in this reconstruction job. The floor of the furnace outlet was built to slope at an angle of about 25 deg. from the slag line at the furnace outlet to the entrance of the waste-heat boilers. The outlet and flue arch was constructed so as to slope in a similar manner from the furnace arch to the boilers. Past experience has demonstrated that with such streamlined connections between the furnace and boilers, it is possible to operate at the maximum smelting rate under low draft conditions, with no attendant smoking or gas

Copper Metallurgy

around the furnace· also a more even distribution of gases between the waste-heat boilers is obtained. With the sloping outlet from the furnace it is necessary to skim the furnace from the side, but this side skimming has resulted in lower slag losses.

The crucible of the furnace, including both sides, firing end, and the uptake end, was lined with a minimum of 18 in. of magnesite brick. This lining extends from 8 in. below the bottom tap hole to a point about 8 in. above the average matte level.

During repair of this furnace, the building over the skimming end of the furnace, flue, and waste-heat boilers, was raised an average of 20 ft., and more lighting and ventilation provided, thus improving operating and working conditions.

An installation for preheating the major part of the air for the combustion of pulverized coal in No. 2 reverberatory furnace was near completion at the end of the year. The air preheater unit is of the Ljungstrom type and will be heated by the gases of combustion from a separately fired coal furnace. The temperature of these gases will be reduced to 750 deg. F., by recirculation of exit gases from the preheater and by air, before entering the preheater. Control is automatic. The Ljungstrom preheater is designed to heat 20,000 cu. ft. of air per minute from 80 deg. F. to 645 deg. F. It is expected that the increased temperatures in the smelting zone resulting from the use of preheated air will improve the smelting rate and provide greater flexibility of furnace operation.

Preparations are now going forward for the installation of a Multiclone system to handle and recover the dust in gases from the converter plant. Under present operating conditions part of the converter plant gases pass through a Cottrell plant, and the remainder go through a combination brick flue and settling chamber to the converter stack. The Multiclone dust-recovery plant will treat all of the converter gases, thus relieving a burden on the Cottrell plant. The dust reclaimed will be fed by a system of screw conveyors to a Redler conveyor, and thence to a conveyor belt system, which in turn will deliver the dust to the reverberatory charge daily.

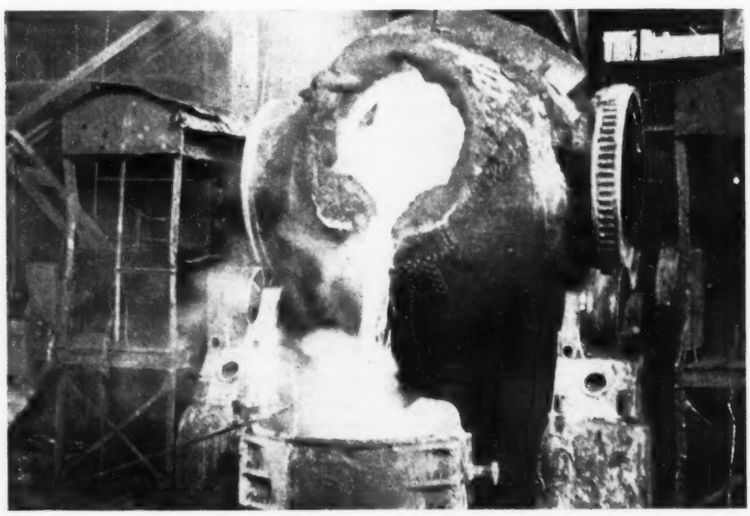
A new steel trestle for the storage of concentrates, ores, and fluxes was in the process of erection in 1941. This trestle will have storage capacity for 40,000 tons, and will supplant an old wooden trestle and the ground storage previously used. The trestle will be on the same level as the central material-handling system which delivers ores, concentrates, fluxes, coal, and other materials to the smelter.

To help meet the greatly increased demand for copper in 1942, Phelps Dodge built a new unit in Arizona in 1941, with an estimated annual output of more than 60,000 tons. The concentrates from the mill will be bedded with other cupreous material and charged directly to the reverberatory furnaces without preliminary roasting or drying. Towards the end of 1941 it was reported that discussions were under way for almost doubling the production at this point by the installation of an additional $28,000,000 plant.

H. M. Burkey, of the American Metal Co., Ltd., reports that the Cotapaxi Exploration Co. is building a small reverberatory copper-smelting plant in Ecuador, which should be completed in the early part of 1942.

In closing I would like to thank the managements of the various copper plants the personnel of which so kindly gave of their time in furnishing me with information.

A Great Falls type of converter in an Arizona smelter



Lead Metallurgy

General trend differs little from that of 1940. Co-operative study of Scotch hearth operation. New developments at Bunker Hill

G. L. Oldright
Senior Nonferrous Metallurgist, Metallurgical Division, Bureau of Mines, Salt Lake City, Utah

MORE PROGRESS was probably made in developing new lead ore-bodies during 1941 than in 1940. A plant was built to volatilize lead and zinc from oxdized products such as slags and another is in course of construction. The general factors governing total production were such, however, that the 1941 production of lead in the United States will be within a few percent of what it was in 1940, and the bulk of the lead will come from about the same sources.

The general trend in the metallurgy of lead was about the same as noted in last year's review. Most of the lead produced continued to come from a few large concentrators; the rest of the smelter feed, such as siliceous ores (preferably bearing precious metals), came from a multiplicity of sources. Copper smelters competing for siliceous fluxes of low lead content made some remarkable records in handling low-grade products. The trend continued in the direction of an "all-sinter" blast-furnace charge (plus coke and scrap iron); the added cost of handling more sinter charge was more than compensated by increase in the capacity of the blast furnace, together with a saving of coke therein. In the United States the typical lead smelter ran its sintering machines nearly to capacity (for a five-day week), but as a rule used only one blast furnace or occasionally two. The smelters, desiring to volatilize lead and zinc from highly zinciferous slags particularly, emphasized the importance of sinter of low sulphur content and of carefully balancing iron, lime, and silica. Current relatively larger increase in the market price for zinc probably will result in smelting more zinc-rich lead-bearing products. Should the market for arsenic continue to improve, operators will receive further encouragement to volatilize this ingredient from byproducts more completely and thus to cut down on the circulating load of dusts and drosses.

Recent papers on Broken Hill operations are of particular interest as pointing out the natural line of development when a large deposit of lead-zinc-silver ore is available, and the metallurgist is not forced to vary his practice to fit rapidly changing ores and ore supplies. Typical metallurgical work of the present three concentrators is summarized in Table I: (O. H. Woodward, Austral. Inst. Min. and Met. Vol. No. 119, Part 1, Sept. 30, 1940, p. 259. Valuable data are included as on percentage distribution of costs of production). See also Table II.

The zinc concentrate is treated at the electrolytic leaching plant at Port Risdon, and the zinc-plant residue therefrom is smelted at Port Pirie. It is planned to re-treat the blast-furnace slag containing about 18 percent zinc and from 2 to 2.5 percent lead in a slag-fuming furnace where it is estimated 85 percent of the zinc can be volatilized. Allowing for the additional metals recovered, we get the following comparison of the percentage of each metal recovered from the original ore in present practice, with what will be recovered when the slag-fuming plant will be installed.

The size of the ore deposits, the storage system, and climatic and other conditions making for uniformity of feed at the Broken Hill smelter have all been factors that encouraged the development of smelting units of large size. With progressive increase in size, there has been a reduction in the harmful effect of variable factors. The new blast roasting plant consists of two machines so arranged as to permit each to be used in preroasting or final sintering. These machines have a pallet 10 ft. wide by 3 ft. 6 in. in length and a windbox 50 ft. long. These two machines will be able to treat the tonnage now handled by 13 Dwight-Lloyd machines of standard size. The blast furnace of latest design is 34 ft. 10 in. by 5 ft. at the zone of the bottom tuyères, which is 17 ft. 10 in. from the feed floor. There is an upper row of tuyères 2 ft. 10 in. above the bottom row. The continuous lead-softening and desilverizing plant throughout 1941 gave many times better results than had the batch system, in terms of bullion treated per hour and oil consumed, and removed 50 times as much "hardness" (in tons) per square foot of hearth area per 24 hours.

For the average concentrator lead recovery was 95.4 percent; the grade of concentrate was 75.3 percent. The sinter cake contains about 47 percent of lead. Part of this dilution is from Risdon zinc-plant residues, lime, sand, and some siliceous ores, but much is from granulated blast-furnace slag. It is estimated that, per ton of new input lead to the blast furnaces, 1.5 tons of total slag is formed, of which but 0.5 ton is new slag. Sintering-machine operators stress the need of an open charge to permit sulphide particles to come into contact with atmospheric oxygen before impenetrable fused products are formed, and usually consider that the final sinter cake should contain under some 50 percent of lead to be sufficiently infusible to keep the sulphur content under 2 percent. As in the 1922 *Proceedings* (Vol. 47, p. 165), Woodward emphasized (Vol. 119, Pt. 1, 1941, p. 276) also the benefits that returned slag gave the blast furnace, such as "the necessary slag flow."

O. P. Chisholm (A.I.M.E. Contribution 116, Nonferrous Metallurgy, Feb. 1941) also notes that an increase in the percentage of slag is, in itself, an aid to securing smoother and more rapid smelting in the blast furnace and also that "perceptible lessening of the amount of lead on the charge . . . has benefited the blast-furnace smelting." (Benefit is also ascribed to a decreased percentage of zinc.) The capacity of some lead blast furnaces has been dou-

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Table I—Summary of Work Done in Concentration at Broken Hill

Product	Percent Weight	Assay % Pb	Assay Oz. Ag	Assay % Zn	Proportion (Distribution) % Pb	Proportion (Distribution) % Ag	Proportion (Distribution) % Zn
Lead concentrate	18.7	77.2	33.0	3.5	96.1	91.4	4.9
Zinc concentrate	22.4	1.3	1.2	53.0	2.0	4.0	88.5
Final residue	58.9	0.5	0.5	1.5	1.9	4.6	6.6
Crude ore	100.0	15.0	6.7	13.4	100.0	100.0	100.0

bled or tripled by the use of "satisfactory sinter," increased use of scrap iron, and decreased percentage of coke on the charge, and yet the lead content of the slag has been kept to under 1 percent. Some of this increased smelting capacity is seemingly ascribed to the increase in permeability of the blast-furnace stock column—"for furnaces where the volume of air is recorded, records show decidedly larger air volumes, with a correspondingly small increase in pressure, or none at all." (The use of air in larger volume would, of course, cause the coke, if present in the same percentage at the tuyères, to burn more rapidly and thus cause the charge column to descend more rapidly.)

Doubtless the benefit given by each of the many factors associated with the great improvements in lead blast-furnace smelting will be evaluated more closely as time goes on. The extent to which it is profitable to dilute the lead blast-furnace charge with barren material will be one of these factors, particularly if marginal fluxes should become less plentiful. The Bunker Hill smelter was one of the first (around 1930) to increase the capacity of a lead blast furnace of standard size to over 400 tons daily, and its charge often contained over 50 percent of lead. That establishment found a shorter smelting column—one between 7 and 11 ft. high, rather than between, say, 12 and 16 plus—to be sufficiently permeable for rapid smelting; with the shorter column and low percentages of coke used, considerable SO_2 also was evolved from sulphides in the charge. At the time, some metallurgists from other smelters with poorer lead charges thought that blast-furnace capacities should be compared in terms of the quantity of slag made, rather than of the total tonnage smelted; less importance was then attributed to improvements made in sintering. The "predigested" slags of present typical sinter cakes have had their ingredients already uniformly admixed, or even chemically combined. Less time is needed to melt unbalanced slag-forming components to bring them into actual contact. The quantity of slag made in smelting now quite likely would be less of a criterion as to smelting performance than when more "direct-smelting" material was used.

The richer the feed to the Scotch hearth, the more lead is produced. During 1941, a cooperative study was carried out by a smelting company and the Bureau of Mines on the reactions and factors governing the rate of producing lead by this unit. Publications are expected during 1942.

Two developments of interest by the Bunker Hill smelter will be noted—the slag-fuming plant, now being erected, and the new electrolytic antimony plant, which operated throughout 1941. It is expected to treat in the slag-fuming furnace the current daily production of about 200 tons of blast-furnace slag, with 100 to 150 tons of cold slag, and to produce from these slags 45 to 50 tons of fume containing (on a monthly basis) about 150 tons of lead and 1,000 tons of zinc. For the present, the deleaded fume will be shipped to a retort plant. Investigations will be carried on, looking forward to treating the product locally. The antimony in the regular ore receipts will be recovered as usual as antimonial lead. The electrolytic antimony plant was built to treat silver ores from the Coeur d'Alene dry-ore belt, in which the silver is associated in part with complex minerals of the tetrahedrite family containing such impurities as bismuth, antimony, and copper. To maintain the 99.99 percent standard of the Bunker Hill lead, these silver ores are treated in a separate plant, as bismuth is not removed from lead by the usual fire methods.

Lead Metallurgy

To high-light the process developed by H. E. Lee and others: The dry ore concentrates containing less than 15 percent of antimony are first graded by a preliminary milling treatment into an enriched antimony concentrate for the dry-ore plant and a pyritic reject which is sent to the main smelter system. The antimony concentrate is mixed with sodium salts and coal and fused in an electric smelting furnace. Slag produced is small in amount and is a low-grade siliceous-aluminous product that is wasted through the regular blast furnaces. The predominant product, an alkali matte containing the bulk of the antimony and practically all of the copper, is tapped at intervals and allowed to solidify in small pots. The silver speiss not dissolved in the liquid matte collects on the furnace bottom, whence it is drained periodically and sent to the cupels to recover silver. Solidified matte buttons are crushed, ground, and leached with water, one gallon being used per 4 lb. of matte. Practically all of the sodium thioantimonate dissolves in half an hour at 140 deg. F. The speiss in the leached residue joins the rest of the speiss at the cupels. Bismuth follows the lead from the cupels. Antimony-rich solutions are electrolyzed in 72 sheet steel cells 12 ft. long by 2 ft. wide by 3 ft. deep, there being eight cells in series in each of nine cascades. Steel electrodes are used. Current density is 20 amp. per square foot. The antimony is stripped after ten days' deposition, drossed in a cylindrical oil-fired melting furnace, and cast into 55-lb. slabs of 99.8 percent metal, under a "starring" slag.

Table II—Over-all Percentage Recoveries "At the equivalent stage of metals in concentrate"

Metal	Average Now Obtained in Mill Recoveries, Broken Hill Co. and Zinc Corp.	As Will Be Obtained by Broken Hill Industry after Fuming Plant Is Installed
Lead	95.4	96.8
Silver	89.4	93.7
Zinc	85.6	91.6

According to the *Salt Lake Mining Review* (Sept. 15, 1941, p. 8) the new slag-treatment plant of the International Smelting Co. now in operation will increase the national zinc production from 1,000,000 to 2,000,000 lb. per month. It is hoped, as soon as the economics of the whole operation have been worked out, also to treat leady ores and products now containing too much zinc to be smelted. Advantage was taken of what had been learned at the International's slag fuming plant in Montana. The general operation is the same, however, up to the point of collecting the volatilized fume from the cooled gases in baghouses. Air and coal are blown through molten slag in a furnace resembling a blast furnace, with a shorter height of charging column. The zinc is volatilized as metal and burns to oxide largely after the vapor leaves the bath. The smaller amount of lead present is volatlized quickly. As the leady zinc fume is not sent to electrolytic zinc leaching plant, this material is passed through a heated rotary kiln to volatilize the lead and to put the remaining calcine into a form more acceptable to mid-Western zinc-retort plants. The lead is returned to the main smelter circuit.

About 30,000 tons of sulphur from smelter gases was marketed on the Pacific Coast in 1940 (*Min. Cong. Jour.* Feb., 1941). As a preliminary step in increasing the percentage of sulphur fixed from lead smelter gases at Trail, data have been collected on "Increasing the concentration of SO_2 in effluent gases from Dwight-Lloyd sintering machines treating lead products." (Bureau of Mines Technical Paper 624, Miller, Bainbridge and Ellison.) The tests showed that by preparing and feeding the sinter charge properly, the strength of the SO_2 gas evolved in the "first-over" operation could be maintained at 5 percent. In most of the tests with stationary pallets, in the "second-over" operation 95 percent of the sulphur was evolved as SO_2 gas in less than 15 min. at a relatively high concentration, in two-thirds of the total gas removed. (The remaining third of the gas contained less than 0.5 percent SO_2 by volume.) Aside from mechanical problems, such as air leakage, the practical difficulties in securing uniformly rich gas arise mostly from the need to establish and to maintain uniform physical and chemical conditions with feed ingredients that vary greatly. This applies particularly to

their changes in physical properties with changes in moisture content. It helped first correctly to proportion and then to admix the ingredients of the charge very intimately, to govern closely the particle sizes of the feed to the pallets, and to keep carefully the optimum moisture content necessary to ignite the cake quickly and thoroughly.

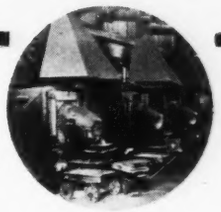
The recirculation of gases through the sinter cake is, of course, one method of enriching effluent SO_2 gases. Even those not fixing the sulphur have found the method useful, as it lessens the load on the dust-recovery system both by giving less gas volume and also by using the sinter cake as a medium for filtering out dust. Some smelters have also emphasized other mechanical methods than seals for control against air leakage into the effluent gases from the Dwight-Lloyd; for example, automatic control of air volumes through the cakes. Smelters nearer industrial centers have to pay more attention to waste gases. They often have an advantage, however, in marketing sulphur in the form of bulky sulphuric acid more profitably. Most of the sulphurous gases made in lead smelting are evolved at the sintering machines, and concentrated SO_2 gas therefrom is well on its way to sulphuric acid.

Data on European lead metallurgy are sparse. The new Trepca Scotch hearth plant fell into German hands. Germany has extended the restrictions of the use of oxidized lead and zinc products for use as pigments. Minerals Yearbook notes an alloy (87 percent Al, 13 percent Si) said to be substituted therefor. "Foreign Minerals Quarterly and Trade Notes" mention that in Brazil a small lead pilot smelter using Mace equipment has started at Apiai, in São Paulo. Cerro de Pasco was scheduled to build an 800-ton zinc-lead concentrator in 1941.

The lead works of Apiai, erected last year under the supervision of the Technological Institute, is a government-owned plant to treat lead minerals produced by numerous exploration enterprises within a radius of 35 km. Prior to this undertaking Brazil had only two medium-sized lead works in Parana, in the southern part of the country—Plumbum, S. A., with a capacity of 2,000 tons per year, and Sociedad Mineracao das Furnas, 4,000 tons per year. Both previously exported their production to the United States but will now ship to Apiai.

This smelter was planned by a Brazilian engineer. The plant has the following units: a central hydro-electric plant; a concentrator able to treat 30 to 35 tons of ore daily; and a smelter and refinery using the Parkes process whereby 10 metric tons of refined lead is produced daily with recovery of all the silver and gold. Silver output ranges from 15 to 70 kg. per day.

Zinc Metallurgy



Industry's efforts bent to increasing metal output. Foreign concentrates brought here for smelting. Zinc from slag at new Utah plant

S. M. Shelton
Supervising Engineer, Ore Dressing Section, Metallurgical Division, Bureau of Mines

H. R. Hanley
Professor of Metallurgy Missouri School of Mines and Metallurgy, Rolla, Mo.

WORLD ZINC METALLURGY outside of the United States and Canada is blanketed in censorship for the duration of the war. The domestic zinc industry has been working feverishly to adjust itself to war economy. Every effort is being made to enlarge production of slab zinc.

American reduction works were required to treat about 1,800,000 tons of zinc concentrates to produce an estimated 862,000 tons of slab zinc.

An estimated 400,000 tons of concentrates was imported from Mexico, Canada, South America, Newfoundland, Africa, and Australia. The trend toward custom smelting of foreign ore is due to two war factors: (1) Axis domination of European countries has placed under enemy control a larger proportion of world smelter capacity than of world mine and mill capacity; excess mill production of the United Nations is being handled to advantage in the United States. (2) Increased demand for zinc requires utilization of all available raw materials, regardless of origin.

The emphasis on imported concentrates is reflected in the greater smelter capacity in East St. Louis, Ill., and in Corpus Cristi, Tex.

Nevertheless, smelters designed primarily for non-custom ores in New Jersey, Pennsylvania, Oklahoma, Arkansas, Texas, Utah, Montana, and Idaho continue to produce the bulk of domestic primary zinc, increasing capacities to meet emergency conditions.

St. Joseph Lead Co. made substantial additions to its electrothermic reduction plant in Pennsylvania, in 1941. One new 12-hearth Herreshoff roaster, 21 ft. 6 in. in diameter, was installed in the early part of the year, and a second one was put in operation in the fall. The sintering capacity was increased by two new 22-ft. sintering machines and a Cottrell precipitator to remove the solids from the gas stream coming from them. Electrical energy transformation has been increased by a 4,500-kva. unit. The result of these improvements, not entirely completed, brought the capacity from an average of 100 tons of zinc equivalent a day for 1940 to 130 average for 1941 through September. Since that time, the daily tonnage has been approximately 145 to 150 tons a day. Foreign concentrates containing 50 to 54 percent zinc and 10 to 12 percent iron were treated satisfactorily. An extension to the acid plant provided a nominal additional capacity of 115 tons of 100 percent sulphuric acid a day.

The operating departments of the American Metal Co. at an Oklahoma plant and one in Pennsylvania, have been expanding their furnaces to 15 blocks operation. Eagle-Picher opened a new block of 800 retorts at another Oklahoma plant that increased smelting capacity about 16 percent.

About Sept. 15, a slag-treatment plant was put in operation by the International Smelting & Refining Company, in Utah, to recover zinc from lead blast-furnace slag. The furnace in which the slag is treated is of the same design as one operated for many years by the Anaconda Copper Mining Co. at East Helena, Mont., to treat slag from the American Smelting & Refining Co. lead smelter.

Old slag dumps of the dismantled smelter at Durango, Colo., were leased. Zinc was not recovered when the smelter operated, and slag runs 10 to 27 per-

cent zinc. The metallurgy of this process was worked out at Tooele some 15 years ago under patents granted to U. A. Garred, which were acquired by International Smelting & Refining Co. and its associated companies.

The basic purpose of the slag-treatment plant is to recover, from lead blast-furnace slag, zinc that has formerly been wasted on the dump. Its effect commercially will be the recovery of the greater part of the zinc that is now being lost in smelting ordinary lead-bearing ores, thus adding 1,000,000 to 2,000,000 lb. monthly to current national zinc production.

The process consists of blowing air and pulverized coal through molten slag in a furnace of the blast type. The zinc is reduced and immediately reoxidized in the upper part of the furnace, forming an oxide fume. Any residual lead is also reduced and the lead again reoxidized in the upper part of the furnace. The gas from the furnace containing the fume is cooled and led to a baghouse, where a zinc fume containing some lead is caught. The lead-bearing zinc oxide is subsequently purified by fuming again in a rotary-kiln-type furnace. Deleaded zinc fume is being shipped to eastern refineries and the lead product returned to the lead plant.

The Combined Metals Reduction Co. began operations in its new 550-ton selective flotation plant in Nevada, in September. Built to treat the complex ores of this district, this plant will provide facilities for the mine output, which heretofore has been denied a profitable outlet.

American Smelting & Refining Co. increased capacity of an existing Texas plant as much as 60 percent in 1941 and output of the Beckemeyer plant about 50 percent. The new electrolytic zinc plant now under construction on the Texas border probably will start operations shortly after the middle of 1942. Steam turbines have been adopted for the generation of power after due consideration had been given to the possibility of gas diesel engines. The contemplated capacity of the plant is 2,000 tons of slab zinc a month from concentrates emanating largely from Newfoundland and possibly from Mexico. The concentrates will be desulphurized by flash roasters built by the Colorado Iron Works under the Trail patents. Waste-heat boilers are being installed to condition the gas from the roasters before it goes to the contact acid division. Every precaution is being taken to suppress dust and fume throughout the plant.

The following operating characteristics have been planned, subject to correction: 180 grams per liter of zinc in the purified solution; the cell effluent to contain approximately 180 grams per liter of sulphuric acid and 60 grams per liter of zinc; a current density of 60 amp. per square foot of cathode surface; and silver-lead anodes spaced at 3 in. center to center.

Zinc Metallurgy

Construction work is planned for doubling the output of the electrolytic zinc plant of the American Zinc Co. in Illinois. The plant, which started operation in May 1941 under adverse conditions as regards dependable composition and uniformity of ore supply, has made a remarkable showing in overcoming the numerous difficulties incident to these conditions. Problems common to most new plants have been at a minimum. The roasted concentrates for the two electrolytic units are to be supplied by flash roasters, one completed in January 1941 at the titanium pigment plant in Missouri and the other now under construction at one of the retort zinc-reduction plants. The roaster gases at the titanium roaster will be converted to acid at the titanium pigment acid plant. At the retort plant mentioned, a new contact acid plant of about 100 tons' daily capacity of 100 percent acid will be erected. A plant is preparing also to treat the byproducts of the electrolytic plant aforesaid, such as melting-furnace skimmings, and purification residues and leached residues for the recovery of zinc, cadmium, copper, and possibly other metals.

In addition to the existing retort zinc plant mentioned above, there are under construction a large, 800-retort, Neureuther furnace and a small, separate, natural-gas-fueled retort furnace for treating melting-furnace skimmings from the electrolytic units.

The Anaconda Copper Mining Co. added equipment at plants in Anaconda and Great Falls, Mont., in 1941, to increase its capacity by 14,000 tons of zinc a year. Sulphide concentrates from the Emma mine, in Butte, which was opened by Anaconda to recover rhodochrosite, provide an additional feed for the zinc plant. Capacity of the Emma concentrates is estimated at 1,000 tons a day. The additions give the plants a total of approximately 180,000 tons of slab zinc a year. Cadmium production capacity was enlarged to accommodate the added production resulting from increase in zinc capacity.

Development in Indium

The process for recovering indium from the zinc-plant residues at Great Falls, Mont., was developed further, so that it is now possible to produce this metal of 99.99+ percent purity in commercial quantities. An assured supply of indium for a large expansion in demand for both 99.90+ percent and 99.99+ percent grades is now available.

The zinc plant of Consolidated Mining & Smelting Co. of Canada was virtually unchanged during 1941. The general flow and treatment of solutions and concentrates remained the same. A second addition of zinc dust in solution purification and extra cleaning of electrolytic cells permitted a fairly steady output of 99.99+ percent zinc. One mercury arc rectifier was added to the cell-room electrical equipment, which is expected to increase daily production of the plant about 50 tons of bar zinc.

The Central mill of the Eagle-Picher Mining & Smelting Co. is going through changes and flowsheet modifications, always increasing capacity. Present operations are at a rate of more than double the original estimated capacity of the MBI differential density or float-and-sink ore-dressing plant that was added.

Bunker Hill & Sullivan Mining & Concentrating Co. concluded arrangements early in 1941 for the installation of a Huntington-Heberlein sink-and-float concentrating unit in its mill at Kellogg, Idaho. The unit will have an estimated capacity of 1,400 tons per 24-hour day. Plans were announced for the construction of a fuming plant to recover lead, zinc, and cadmium from smelter slag.

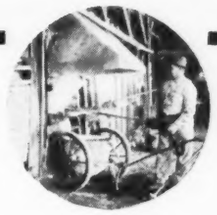
Zinc-utilization metallurgy was in 1941 subjected to influences much different from those of process metallurgy. Pressure was applied to decrease zinc consumption in the face of rising demands. The industry cooperated to devise reductions, substitutions, and longer life for zinc and zinc-coated products.

The consumption of zinc for galvanized sheet is being held within rigid limits and probably will be reduced with the trend toward non-metallic substitutes. Galvanized shapes and products show increased consumption because the galvanized products are used in place of brass and copper, particularly as pipe and tubing.

Alloy, as well as plastic coatings for steel, is receiving attention. On development is the "Corronizing process." Corronizing is a coating consisting of a number of very thin layers of metals and alloys having unusual corrosion-resisting properties. Zinc and nickel or tin and nickel are electrodeposited in separate layers, then heat treatment is employed at 500 deg. to 750 deg. F. to alloy the metals as a uniform coating.

The "Cronak" process consists of decreasing and cleaning galvanized sheet or products, then dipping in diluted hydrochloric acid, followed by a dip in a dichromate solution, rinsing, and rapid drying at low temperature. The treatment, which produces a bronze tint on the surface, is declared to provide protection for the underlying metal, particularly from corrosion by stagnant water.

The Uncommon Metals



Most of them required for emergency program. Additional reserves are sought. High spot of year is the magnesium boom

V. H. Gottschalk
Senior Physicist
Metallurgical Division,
Bureau of Mines
College Park, Md.

THE outstanding development of 1941 in the field of uncommon metals is unquestionably the magnesium boom. It is estimated that by the end of 1942 the amount of magnesium metal produced in the United States should be about 100 times the output for 1937. When magnesium reaches this tonnage stage, it will no longer be an uncommon metal.

Generally, defense needs have led to intensive search for new domestic deposits and sources of most of the uncommon metals, with enough success this year to augur well for the postwar status of this branch of metallurgical industry.

MAGNESIUM—January, 1941, marked the beginning of the first production of metallic magnesium from sea water. The new technologic feature involved in this achievement is the economic concentration of the 0.12 percent magnesium content of the sea. A fundamentally different method for making magnesium is direct reduction of magnesium oxide by carbon at 2,000 deg. C; this is being done at a new plant that started operation about the middle of the past year in California. The magnesium metal so reduced would reoxidize if allowed to cool in the carbon monoxide atmosphere resulting from the process and hence is quenched by the admixture of a large volume of cold natural gas. The idea of direct reduction by carbon underlies also the Bureau of Mines method, but in this case, the resultant magnesium vapor is shock-cooled by a spray of oil. Another type of direct process—reduction of more or less impure magnesia by ferrosilicon in a high-frequency induction furnace—is being tried on a pilot-plant scale at Ottawa, Canada.

Another plant, now building in southern Nevada, will produce magnesium by the electrolysis of fused magnesium chloride obtained from the magnesite at Luning, Nev. Some magnesium metal will be made from the waste magnesium chloride liquors produced in the potash industry at Carlsbad, N. M., where also waste chlorine and hydrochloric acid gases are recovered to produce still more magnesium chloride from dolomite. Recovery of magnesium chloride from dolomite is becoming almost general; for instance, at one plant in Ohio burnt dolomite will be used in the ammonia stills, and the resultant mixture of calcium chloride and magnesia is then worked up further to yield magnesium chloride. A similar recovery of magnesium chloride from burnt dolomite by its reaction with waste calcium chloride will be practiced in at least one other industry.

As an offset to the competition for raw materials that seems inevitable between the producers of metallurgical and non-metallurgical magnesium products, the magnesium sulphate obtained as a waste byproduct of sodium sulphate recovery at Great Salt Lake and Searles Lake is now being turned to use in the production of the magnesia refractories essential especially for lining the large open-hearth furnaces of the steel industry.

MANGANESE — Domestic manganese ores, although furnishing only about 3 percent of the total consumption in 1941, nevertheless promise to be adequate should the emergency come when stockpiles are depleted and imports cut off. The Bureau of Mines' pilot plant in Nevada began operations in August, and is proving itself a valuable guide to industry on the feasibility and cost of metallurgical operations involved in the production of manganese and other strategic metals from domestic ores.

The Bureau is also operating the experimental ore-dressing plant built by the Government in South Dakota, with the object of getting flowsheets and cost estimates for the recovery of manganese from the local deposit, which contains one of the country's largest stores of this strategic element. The problem is to separate 2.5 percent of manganese-containing nodules from a stiff, sticky material classified technically as a shale. The nodules consist essentially of a mixture of the minerals rhodochrosite, siderite, and magnesite from which the manganese cannot be extracted economically by methods now in use. Irrespective of what the commercial significance of this low-grade deposit may prove to be eventually, the present study would be justifiable as insurance against disaster in extreme emergency, since it should provide the War Department with a complete file of designs and data indispensable for making this large supply of manganese immediately available when needed.

The Boulder pilot plant is also improving the process for making electrolytic manganese, which at present has the following industrial uses: In stainless steels; for the manganese-copper-zinc alloy used as a base in silver-plating; and for making bimetal strips now used extensively in thermostatic devices.

CHROMIUM—A Canadian concern claims to have solved the problem of making an economically commercial substitute for ferrochromium from domestic ores. This product is called Chrom-X and is reported to have received favorable comment from open-hearth operators. Although it is difficult to judge from the meager details available, it seems that though Chrom-X simplifies the addition of high-iron chrome concentrates to the steel bath, it does not solve the domestic chromium problem, which is to make high-chromium, high-iron concentrates from domestic ores.

The indications are that a number of large concerns, with long experience in the technology of the uncommon metals that are added to steels, are studying this chromium problem intensively.

BERYLLIUM—Beryllium-copper is being marketed in increasing quantities. The nickel-beryllium alloy employed in Germany has not yet found extended use in this country, and a new study of aluminum-beryllium alloys made in the hope of finding a better piston material has been disappointing. The announcement of success in

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making 20 to 30 percent beryllium alloys by powder-metallurgical methods (called "metalloceramics" in Europe) is interesting but does not appear to have found commercial application.

COBALT—There are now two plants in the United States regularly producing metallic cobalt, one from the Pennsylvania iron ores mentioned in last year's review and the other from South African ores formerly smelted in Belgium.

BISMUTH, SELENIUM, TELLURIUM, AND CADMIUM—Bismuth makes stainless steel (18:8) machinable without impairing corrosion resistance. The effect of this addition (0.1 to 0.5 percent Bi) is said to be so remarkable that it is predicted that it will quickly displace the selenium that up to now has been regarded as the best addition for making 18:8 machinable. In one way this is fortunate, because larger quantities of selenium are now required in the new selenium rectifiers that are used extensively.

Because the only source of selenium is the anode mud from copper refineries, where it is always associated with tellurium in an almost constant ratio, this use of larger amounts of selenium makes the problem of surplus tellurium more acute. There are hints that some new uses for this excess tellurium will soon be announced.

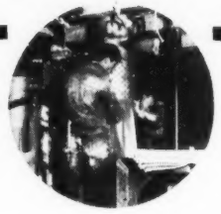
Cadmium, which also is handicapped by its association with another metal (zinc), was limited further in its use in 1941 by legislation. Sanitary codes are beginning to prohibit use of it in articles that come in contact with food and drink, lest poisoning result.

MOLYBDENUM AND TUNGSTEN—Molybdenum, of which we have abundant supplies, is again replacing some or all of the less-common tungsten used in high-speed tool steel. An interesting new development is the imminent production of pure unalloyed molybdenum metal for use in high-temperature electrical resistance furnaces. Resistors of pure molybdenum metal made in America are to appear soon on the market for industrial use.

MERCURY—The rising price of mercury has stimulated the opening of many cinnabar deposits, and it is claimed that domestic production (supplemented probably by similar developments in Latin America) has now made us wholly independent of the former European sources that supplied our main requirements.

INDIUM—This metal, which was but a museum curiosity a few years ago, has now become available in limited commercial quantities at a price that encourages hope for new uses. The search is on and some major discovery is not at all unlikely.

Industrial Minerals



Record demand, higher costs bring little advance in prices. Bauxite, kyanite, magnesite, mica are among those most affected

Samuel H. Dolbear
Consulting Engineer
17 Battery Place, New York

THE NON-METALLIC or industrial minerals industries in 1941 were again characterized by record demand, greater production, increases in costs or labor, equipment, and materials, and, with one or two exceptions, no compensating increases in the price of products. Normal channels of flow were further disrupted by the political fortunes of Europe. The effect of war in the Pacific in December will be more fully reflected in the statistics of 1942.

Extension of the war makes increasingly evident the necessity of either self-sufficiency in this hemisphere or the accumulation of stockpiles sufficient to carry through any conceivable emergency. Those substances particularly affected are bauxite, industrial diamonds, kyanite, magnesite, and mica. Greater dependency is also placed on certain American raw materials because of the exclusion of foreign manufactured goods. The increased activity of American feldspar mines, for example, is in a large measure due to the absence of imports of pottery, table ware, and glass from Central Europe and Asia.

American producers have already begun to consider plans to meet a renewed struggle for markets which inevitably follow the termination of war. The freezing of domestic stocks and prices, temporary exclusion of imports, and other schemes are being proposed to prevent a collapse of industrial activity such as that which followed in 1918.

ASBESTOS—All asbestos mines and mills in the Quebec area operated at ca-

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CERIUM—Monazite sands are now of value chiefly for their content of cerium, the salts of which have found various applications in industrial products. In fact, there is a real shortage of cerium, which has led to renewed interest in the Florida beach sands, which contain some monazite. This might conceivably be made commercially available by working up the sands for their titanium and zirconium minerals. Until this year, metallic cerium was used only as the pyrophoric ferrocerium that causes the sparks in the gas lighters found in most chemical laboratories. This year, however, cerium has been suggested seriously as a component of several alloys. The findings of a German expert—that a 2 percent addition of cerium has a remarkable effect on the fluidity of cast iron and also acts as a desulphurizer and increases the tensile strength—are distinctly disturbing because these properties are of such fundamental significance that any means shown to be effective for improving cast iron in these respects is almost certain to be adopted. However, there will first have to be a decided increase in the production of monazite.

OTHER METALS—Antimony, vanadium, titanium, zirconium, columbium, tantalum, and other uncommon metals not mentioned in the foregoing are actively continuing development, not only in extent of their use but also (and this to a remarkable degree in some instances) in the volume of their domestic production. Much of this activity, of course, is directly connected with national defense and may lapse when world trade is again unhampered, but a considerable fraction is undoubtedly destined to be permanent and to exert a great influence on the trend of the uncommon metals in the future.

pacity in 1941, with the exception of the Black Lake mill of Johnson's Co., which was idle the first six months, and the British-Canadian mill, at Black Lake, of Asbestos Corporation Ltd., which resumed operations in September after a shutdown of a year. For the past few months of the year, the mills of Canadian Johns-Manville Co., Ltd., were operated on a schedule of seven days a week.

Canadian mines are now without normal markets in continental Europe and the Far East, but the United States demand has increased with sufficient rapidity to absorb this loss. Statistics of United States imports from Canada are expected to show an increase of 50 percent more than those of 1940.

Prices have been unchanged during 1941, but a 10 percent increase as of Jan. 1, 1942, will apply to deliveries in the first quarter.

BARITE—Contrary to most industrial minerals, productive activity in barite was 5 percent below that of the previous year. The National Lead Co. placed a new barite plant in operation in Arkansas in December. The Magnet Cove plant is now using flotation. Crude prices advanced 50c. a ton during the year. The outlook for 1942 is for greater activity than in 1941.

BAUXITE—The huge increase proposed in the production of aluminum is reflected in the plans to utilize low-grade Arkansas bauxite and bauxitic clay in the Government-financed plants and the plans of the Olin Corporation to utilize alunite from Utah and Nevada.

European bauxite is no longer sent to the United States. Prior to 1941 Germany controlled the Hungarian, Italian, and Rumanian deposits and during 1941 this control was extended to the Balkans and into Greece.

The German armies also took over the Dnieper and Volkhov aluminum plants from Russia and were on the border of the Tikhvin bauxite field in their farthest advance toward Leningrad. Russian aluminum production at the Kamensk plant, in the Urals, is reported being increased, the plant being supplied by bauxite deposits situated in the Urals.

Production from the Surinam (Dutch Guiana) deposits increased from 586,000 tons in 1940 to about 1,200,000 tons in 1941, half of this output coming from new fields.

Prices f.o.b. shipping point showed little if any increase. Transportation rates, however, resulted in a considerably higher delivered cost.

The U. S. Bureau of Mines has successfully applied flotation to bauxite on a laboratory scale, but these results still lack confirmation in the pilot plant. Plans to utilize low-grade material are expected to result in important technical developments.

Production was discontinued in Netherlands Indies and Malaya in 1941, causing the Japanese to revert to Korean alunite and Manchurian bauxitic shales. The production in India was delayed by difficulty in obtaining structural material and equipment.

BENTONITE—Production in 1941 in the Black Hills and in Mississippi increased about 55 percent notwithstanding a reduction in exports to the United Kingdom.

Prices were little changed until October, when a slight decline occurred due to the expiration of the Kraus patents covering the use of bentonite for bonding minerals. The decline corresponded to the amount of royalties heretofore paid. The chief growth in the use of bentonite during the year was to prevent water seepage. It is still only a minor outlet compared to that demanded by foundries and oil wells.

Consumption in 1942 may drop if the decrease in automobile manufacture is not replaced by the manufacture of other types of castings in these plants.

BORAX—A shortage of borax brought about by a four months' strike at the Trona plant of the American Potash & Chemical Co. resulted in placing both borax and boric acid under full priority control. The shortage, however, was remedied by resumption of operations in July, and the control order was withdrawn. Prices remained unchanged from those of 1940.

Exports are greatly reduced, but domestic demand more than offset the loss of foreign business. Much of the current unprecedented demand has been due to increased use for glass kitchen ware, tubes for efflorescent lighting, glass fabrics for electrical and other insulation, and the larger use of glass containers to release tin for defense purposes.

CRUSHED STONE—Though statistics are not yet available, it is believed that both fluxing limestone and construction stone reached their highest levels of production in history in 1941. Crushed stone has been required in the construction of defense plants, airports, cantonments, military highways, and other war structures. The location of much of this work at a distance from stationary plants has brought out increased activity for portable plants.

Prices have been stationary in most places. It is believed there will be an increased demand for fluxing stone in 1942, but the completion of defense projects and the restriction of civilian housing is expected to result in lesser demand for construction material.

FELDSPAR—A high rate of operation prevailed during the first nine months of the year but fell off during the final quarter. Notwithstanding this, the annual rate of operation was close to the high point of the last five years. Curtailment of building construction may be responsible for the falling off, and this may continue during 1942. Reduction of imports of chinaware and glass has increased the business of domestic tableware and pottery producers, who have been working at capacity.

The average price of feldspar increased by less than 1 percent, and it is expected to remain more or less stationary despite increased demands and costs, as the productive capacity of mines is still two or three times the sales volume.

The Clinchfield Sand & Feldspar Corp. is erecting a plant at Bedford, Va., to replace that at Brookneal, destroyed by fire. Consolidated Feldspar Corp. is building an aplite plant at Piney River, Va.

FLUORSPAR—Production of domestic mines is reported to have been much larger in 1941 than in the previous year. In addition to mines producing in 1941, the Rosiclare mine was reopened after having been flooded since 1924. The Navajo Fluorspar Mines, near Grants, N. Mex., also made substantial shipments.

Imports for the first nine months of 1941 were 7310 short tons, compared with 10,045 tons for the corresponding period in 1940. During the past year Mexico supplied 4238 tons, Spain 3070 tons, and the United Kingdom 2 tons.

Prices of fluxing-gravel fluorspar, f.o.b. Illinois-Kentucky mines, increased from $20 per ton in January to $23 per ton in October.

Unless there is an improvement in foreign situation, the demand for domestic material is likely to be much higher in 1942.

KYANITE—The kyanite quarry of the Kyanite Products Corp. situated in Virginia, produced at the rate of 450 tons per month during the year 1941. This is the principal American mine.

Imports of kyanite come entirely from India, the amount in 1940 being 7658 tons. Imports for the first nine months of 1941 amounted to 6714 tons, representing a somewhat accelerated rate.

On July 1 prices were raised $2 over a base price of $15 which had been in use since the company began operation in 1938.

Research work has been largely toward development of some process of agglomerating fines to produce a satisfactory substitute for the massive Indian kyanite.

As 75 percent of the output is used as a refractory by industries engaged in defense work, continued activity in 1942 is anticipated.

MAGNESITE—The Northwest Magnesite Co., in the Northwest, continued in 1941 to be the largest pro-

ducer and operated at capacity. A new kiln was installed late in the year, which will increase output by 50,000 tons. A plant to produce 35,000 tons per year of artificial magnesite is being erected in an eastern State, and will utilize a British development in which dolomite is treated with sea water.

Proposed use of magnesite as a source of magnesium metal forecasts a new demand which may ultimately require several hundred thousand tons of raw material. Extensive plans to operate deposits near Luning, Nev., are being made by Basic Ores, Inc., Westvaco Chlorine Products Co., and the Permanente Corp. A calcining plant costing $3,500,000 is being erected in the same State as the deposits, and its output will presumably go largely into the manufacture of metallic magnesium.

No foreign magnesite has been imported since April, 1941, and prices for refractory grades from Washington have remained unchanged, notwithstanding the unprecedented demand and higher costs. One manufacturer, however, is reported to have increased the prices of both maintenance grade and brick-making grade by $4 per ton.

MICA—Domestic production was greatly expanded in 1941, preliminary estimates indicating an increase of 50 percent. Consumption of muscovite splittings, block mica, and ground mica were all 50 percent or more greater than during the 1940 all-time high record.

Prices increased only slightly, most grades of domestic mica being quoted at somewhat under 1940 peaks. Imports from Brazil have increased, due to the elimination of continental Europe and Japan from the market. Supplies of amber splittings from Madagascar are small and expected to cease altogether.

Sericite deposits of South Carolina are being mined and the output sold as a filler, particularly for paints. It is also claimed that the material can replace a substantial amount of zinc oxide in rubber.

Research continues to seek substitutes for mica, and certain of these have been successful, particularly in relatively low-temperature electrical requirements.

The outlook is for an unprecedented demand in 1942 and a serious shortage due to difficulty in obtaining shipments from India and Madagascar. A continued increase in domestic production is anticipated.

PHOSPHATE — Phosphate - rock producers of Florida and Tennessee operated in 1941 at an increased rate over 1940, and nearly to capacity. Practically no phosphate rock is now imported, so there is no change in the foreign supplies situation. However, world supplies of phosphate rock have been curtailed, due to the war, and increased shipments over 1940 have been made from the United States to the world market. No new sources of phosphate rock were developed, nor new operations of importance started in 1941.

Industrial Minerals

The prevailing prices were somewhat higher than for 1940, but this was due principally to increases in cost of labor and fuel.

The outlook for 1942 is for a larger production than for 1941, and prices may be somewhat higher because of increased costs.

PORTLAND CEMENT—The cement industry operated close to capacity during 1941. No new plants were built, due chiefly to the lack of capital, but the Permanente Corp. in California increased its capacity to 16,000 bbl. per day, making it the largest operation in the country.

Imports dropped to negligible amounts, but exports, particularly to Latin America, were larger than those of 1940.

Notwithstanding increases in labor, fuel, and repair costs, prices remained stationary. Increased costs were absorbed in many cases by better operating conditions. The chief technical developments have been the growing use of centrifuges in both classification and beneficiation and the adoption by A.S.T.M. of new specifications of five kinds of cement. It is believed the general use of these specifications will be deferred during the war demand.

POTASH—Domestic production in terms of K_2O was 480,000 tons in 1941, which will be further increased to 600,000 tons in 1942. This cares for all domestic requirements and permits exports to friendly countries.

Potassium sulphate formerly imported is now being produced by two companies in New Mexico and one in California.

The basic price of 53½c. a unit, f.o.b. Atlantic Seaboard, less seasonal discounts, remained unchanged in 1941 notwithstanding increased demand and higher costs. Labor alone has increased 25 percent since July 1938.

A report is current of an increase of 2.54c. to 4.54c. per unit for 1941-42 contracts for 50 percent K_2O muriate from New Mexico mines. Sulphate was increased $2 per ton for the same period.

Plant improvements have brought increased recovery. Trackless haulage with shuttle cars powered from trolley wires was introduced at one New Mexico operation.

The United States Potash Co. was in 1941 granted a discovery value of 85c. per ton on 14,000,000 tons of potash by the Board of Tax Appeals. The company sought $2 and the Treasury contended for 27½c. per ton.

Imports during 1941 were 20,000 tons of 50 to 60 percent muriate from Spain and 16,000 tons of high potash nitrate from Chile.

PRECIOUS STONES—The dislocation of the diamond industry is indicated by the fact that normally 25,000 cutters are employed, chiefly in Holland. Today fewer than 1,000 are employed, 600 of these in New York. This situation has resulted in a shortage of small sizes of cut diamonds, which is reflected in the price, which has increased 200 to 400 percent since 1939, whereas the price of large stones increased only 15 to 20 percent.

Although statistics are not published at present, it is believed that mine production has remained fairly constant.

Demand for diamonds, sapphires, and other industrial grade stones is active. The entire output of diamonds from Brazil has been purchased by the U. S. Government.

SULPHUR—The sulphur deposits of the United States produced 3,150,000 tons in 1941, chiefly found in Texas and Louisiana, representing a record production exceeding by 15 percent the previous high record of 1937. Stocks above ground in producers' hand amounted to 4,200,000 tons at the beginning of the year and dropped by possibly 150,000 tons by the end of December. Consumers had, however, increased stocks by that amount.

Exports were made chiefly to countries of the United Kingdom, with smaller amounts going to South America.

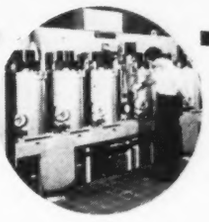
Coastwise shipping of sulphur was curtailed and a large tonnage moved through barge canals and the Mississippi River to inland and Canadian points. Rail shipments also increased. Transportation costs were, therefore, 200 to 300 percent higher.

The price of sulphur f.o.b. mines in 1941 remained unchanged at $16, but the cost delivered to the consumer was higher.

With the construction of new acid plants, the consumption for 1942 is expected to increase substantially.

The "kaolin and ball clay" industry in the United States produced 1,050,000 short tons of clay in 1939, valued at $7,214,000, according to figures released in December, 1941 by the Bureau of the Census. The industry comprised 95 pits or mines and 53 associated preparation plants, in 19 States. Operations in Georgia reported almost half the total output; those in South Carolina and California were the next largest. The major part of the crude material was mined from open pits. About 73 percent of the clay produced was reported as a prepared product; the remaining 27 percent was crude clay.

Electrometallurgy



Aluminum and magnesium occupy limelight as production requirements rise. New and larger plants planned. Others start up

Arthur A. Center
Consulting Metallurgist
25 Broadway, New York

THE RELATION of the United States to the present world conflict and the ensuing metal demands were so radically revised during 1941 that much of what was written about plans for some of the metals had little meaning at its close. This was especially true of aluminum and magnesium.

ALUMINUM—United States production of primary aluminum in 1940 was 206,280 tons, or 26 percent over the previous all-time high. The total for 1941 will be about 50 percent greater than for 1940. The rate aimed at for early in 1941 by enlargements and new plants was 400,000 tons per year. At mid-year the rate aimed at, by further expansion which is to run through 1942, was over 700,000 tons. Of this something less than 40 percent is to come from Government-owned plants. Plants owned by the Aluminum company will have a rated capacity of 370,000 tons. It will also operate Government-owned units of 75,000 tons' capacity in the East; of 50,000 tons in the Mid-West; and of 45,000 tons in the Northwest. Reynolds Metals is operating or has under construction units of a 50,000-ton plant in a Southern State, and of a 30,000-ton plant in the Northwest. These are Government-financed. Bohn Aluminum & Brass will operate a 35,000-ton Government-owned plant in California. A 35,000-ton Government-owned plant is also being built in Washington and will be operated by Union Carbon & Carbide, and a 15,000-ton plant, also Government-owned and to be built in the same State, will be operated by the Olin Corporation.

Bauxite for these plants is to come largely from Surinam, 1,300,000 long tons high-grade, and somewhat more than this tonnage of domestic high- and low-grade from Arkansas. The bauxite will be processed at various convenient points in the South and the Mid-west region. One of these plants is scheduled to make 560,000 short tons of alumina, a second plant 365,000, and two remaining plants 250,000 tons each. These were or are being built under Aluminum company supervision and will be operated by the company. The last two plants are to be Government-owned. The Reynolds plant, of 100,000 tons capacity, is Government-financed.

Canadian production of aluminum is also being increased to fulfill contracts with the United States for 340,000 tons, delivery to extend into 1944. Its production in 1940 was 94,000 tons.

The Bayer process for producing alumina remains the most advantageous when cheap coal is at hand. It permits easier control of the titanium content in ores. For 1 ton of alumina a little over 2 tons of bituminous coal is required in the Bayer process.

Power consumption over the world now ranges from 8 to 12 kw.-hr. per pound aluminum. Cryolite consumption amounts to around 160 lb. per short ton of metal produced. Electrode requirements now range from 1,000 to 1,400 lb. per ton of metal. Petroleum coke remains the most desirable material for electrodes and is not available in quantity to Axis powers. The United States supply continues to fall off as application of new cracking methods spreads. Cells have been increasing in size and efficiency. The inclosed cell, operating with large Soderberg, self-baking, continuous electrode and at high amperage, is making low operating costs with lowered power and electrode consumption, and yielding purer metal. The larger open cells use a current of 25,000 to 40,000 amp.; the inclosed, 50,000 to 55,000 amp. Vaporized material and dust from the inclosed type can be used for replacing cryolite lost from the bath.

Single-stage ignitrons are replacing multistage rectifiers in the power-conversion stations of new plants. The latter have a voltage drop of about 29 volts. This has been the big obstacle to rectifiers attaining higher conversion efficiency than the rotary converters. The ignitrons are doing this and are more flexible in operation and less subject to arc-backs.

Aluminum of 99.99 percent grade can be made commercially. It is found to be more resistant to many corrosive conditions than the former highgrade 99.5 percent metal.

Baimakov, Batashov, and Enlaimkov varied the composition of the electrolyte at the anode and the cathode to study electrode processes. A porous diaphragm showed cataphoretic migration of cryolite-alumina from anode to cathode. The catholyte gained sodium and lost fluorine and aluminum. With the diaphragm in use it had excess sodium fluoride content of 51 percent; without, 8.5 percent. The anolyte had excess aluminum fluoride content 23 percent with diaphragm in use; without, 5 percent. Agnini investigated electrolysis and developed a theory that it occurs in two main steps—first, that electro-chemical action separated sodium metal at the cathode and fluorine at the anode; second, that sodium reacts with aluminum fluoride to form aluminum metal and cryolite. The aluminum fluoride is presumably formed by pyrolysis of cryolite and is regenerated continuously at the anode by the action of fluorine on Al_2O_4 ions.

Government work on making alumina at Muscle Shoals from clays is going forward at the rate of 1 ton of alumina per day. Kalunite Co. is working on making alumina from alunite in Utah and clays in a plant to make 1,000 tons of alumina per month. Hixon and Klein reported on an acid process for making alumina from ores. It involves leaching with hydrochloric acid; extracting the dissolved iron with an organic agent (immiscible in water); such as an ether; evaporating and calcining the aluminum chloride to alumina; and finally in regenerating and recycling the acid and the organic agent.

CALCIUM—A very good article by A. B. Kinzel may be found in *Mining and Metallurgy* for October, 1941.

CHROMIUM—The Bureau of Mines in R. I. 3600 reported on promising experimental work of producing high-purity chromium from aqueous solutions of trivalent salts in preference to the hexavalent acid or chromates. Chromium Mining & Smelting Corp.

is producing by electrothermic smelting of low-grade ores a high chromium-iron ratio concentrate, which can be used to produce ferrochromium. The plant uses 24,000 kw. It is claimed the principles of the process can be applied to iron, manganese, silicon, vanadium, tungsten, nickel, copper, and other alloying metals.

COBALT—R.I. 3600 also relates experimental work on electrowinning of cobalt from ores. Union Carbide & Carbon built a $600,000 plant at Niagara Falls to refine Katanga cobalt ore.

COPPER—Phelps Dodge production in Arizona may be practically doubled at Government request. Figures have been given of an R.F.C. loan of $28,000,000 for a greatly increased production of the metal per year. Canadian electrolytic refining capacity was markedly increased. Mt. Morgan plans a refinery near the mine to take care of Queensland requirements, instead of shipping, as now, to Port Kembla. India started up its second electrolytic refinery.

The combined capacity of the two plants exceeds domestic production, and some Rhodesian blister is being refined. China is reported as building two small refineries to take care of domestic production. Plans were reported made to increase the Bor, Yugoslavia, electrolytic production to 66,000 short tons by 1943. The Outokumpu, Finland, refinery was completed early in the year.

MAGNESIUM—Production of the United States in 1940 was 6,250 tons, or 87 percent above that of 1939. Dow Chemical Co. was the sole producer and doubled the capacity of its Michigan plant early in 1940. In January, 1941, it started up its new plant in the South, which produces magnesium from sea water. Production in 1941 should be greater than in 1940. Early in the year the 1942 production was planned to be around 26,000 tons. The estimate was shortly raised to 38,000 tons by reason of the Permanente electrothermic plant as then projected. In June the O.P.M. recommended that 200,000-ton per year capacity be aimed at by the end of 1942. The latest arrangement is as follows: The Michigan plant was raised to 9,000 tons; the Southern plant was raised to 18,000 and then increased another 36,000 to 54,000 tons; the Mathieson Alkali Co. plant to produce 18,000 tons in Louisiana, by electrolysis of magnesium chloride made from its dolomite deposit at Burnett, Texas; Basic Magnesium, Inc., 56,000 tons in southern Nevada from its magnesite-brucite deposits near Luning, Nev.; Diamond Alkali Co. 18,000 tons in Ohio by the Dow process; Union Potash & Chemical 12,000 tons in Texas, by electrolysis of magnesium chloride obtained from its potash operations at Carlsbad, N. M.; and possible ultimate capacity of 36,000 tons in California by the Hansgirg electrothermic process using ore from the Basic Magnesium Co.'s Nevada deposit. Aside from the Basic Magnesium and Permanente plants the Dow process will be the basis of plant operations in the main. Basic Magnesium is being built in conjunction with English engineers and is expected to be based on English practice.

Electrometallurgy

Dow's Southern plant was built to recover bromine from sea water as well as magnesium. Oyster shells are dredged from the Gulf waters and taken to a point nearby. Here they are burned to lime in a 300-ft. Traylor lime kiln. Lime slurry, obtained from a 150-ft. Dorr thickener, is added to sea water in a 28x80x14-ft. deep Dorr flocculator to precipitate magnesium hydrate. This goes to 200-ft. Dorr thickeners. The spigot product is sent to large Moore filters with about 100 leaves per basket. The cake builds up to 1 in. or more, and is dropped into rubber-lined steel tanks, where a 10 percent hydrochloric acid solution is added to form magnesium chloride solution. The first step of driving off the water is to spray the solution into brick-lined furnaces (20 ft. dia. x 40 ft. high). The concentrated solution then goes to Shriver plate-and-frame presses to remove crystallized solids, the filtrate going to shelf dryers (50 ft. dia. x 50 ft. high), with 12 shelves sloping to the center. The filtrate is fed at the circumference. Solids are raked to the center and fall to the lowest shelf. These solids are sent to a rotary dryer to obtain the magnesium chloride anhydride required for the electrolytic cells.

The California plant uses a modified Hansgirg electrothermic process. Magnesium ore is calcined to oxide. Pitch is added to form briquets, which are charged to the 8,000-kva., 3-phase, electric-arc furnace lined with carbon brick. Later furnaces may be increased to 12,000 kva. A hydrogen atmosphere is maintained. Magnesium is reduced and vaporized. Vapor and gases are drawn off and rapidly cooled from about 2,000 deg. C. to about 200 deg. by adding 25 volumes of natural gas. The cooled gases and magnesium pass to large cylindrical drums on the walls of which the magnesium condenses and solidifies. It is removed by revolving scrapers. The dust is caught by an electrostatic precipitator and a bag-house. Gases not returned, around 25 percent, are used in the company's cement plant. The dust contains 60 to 65 percent metal plus magnesium oxide plus carbon. It is compressed to tablets without a binder and charged as a batch operation to sealed, electrically heated retorts, kept under high vacuum. A retort produces a little more than 1 ton of metal in 72 hours. The first unit, rated at 4,000 tons' annual capacity, has 36 such retorts. Its walls are water- and oil-cooled. The top section is removable to get out the crystallized magnesium. The metal, it is claimed, is of 99.97 percent grade, as against 99.90 for electrolytic metal. More than one explosion has occurred since starting.

The Bureau of Mines has done experimental work on electrothermic production of magnesium from ores since 1936. To cool the vaporized magnesium, obtained by carbon reduction in an electric furnace, a hydrocarbon oil, such as a light stove oil, is sprayed as a mist into the furnace gases. A slight excess over what is vaporized is introduced, serving to collect the condensed metal dust. The sludge is sent to a centrifugal separator, the rest of the oil distilled off, and the magnesium recovered as liquid metal.

Germany is reported as experimenting with direct thermal reduction of magnesium oxide; Italy is building a relatively small plant at Cogne, near Rome, to use sea water.

MANGANESE—The Bureau is completing its hydrometallurgical pilot in Nevada, to be operated on a semi-commercial scale, and will complete the electrolytic section later. The Electro Manganese Corp. plant in Tennessee is making 2 or more tons of metal per day. Italian work reports that manganese sulphamate, 50 g./l., with $NH_4SO_3NH_2$, 100 g./l., produces good deposits and yields, but that all anodes including graphite are readily attacked.

NICKEL—International Nickel has been further expanding production to meet demands. It continued to treat Falconbridge's entire output of matte from smelter operations. Companhia de Nickel do Brasil can treat 15 tons of ore per day by electric-furnace smelting to make ferronickel. Brazilian deposits are reported by U. S. Government engineers to be large enough to supply most of United States requirements.

TIN—Trail is reported as starting early in 1942 to produce about 500 tons of metal a year by electric smelting. Concentrate is obtained from the small amount of tin occurring in Sullivan ore. Over-all recoveries are given at about 45 percent with a concentration ratio of over 2,000 to 1. High-grade concentrates, 70 percent tin, from the Dutch East Indies were contracted for by the United States to sweeten the low-grade Bolivian material at the new tin smelter in Texas. If the flow of high grade is interferred with, electrolytic refining may prove of help.

ZINC—Zinc developments will be found in the article on zinc metallurgy in this issue.

Mine Equipment

New designs gradually being curtailed by priorities. Manufacturers and miners to get standard supplies for record output

H. C. Chellson
Associate Editor

A YEAR AGO effort was directed by manufacturers and mine operators to utilize new and improved equipment for defense. Today, that effort has grown to a powerful coordinated force moving on a 24-hour seven-day per week basis to produce metals for victory. Mine operators will see fewer improved designs or new pieces of equipment announced by manufacturers, because more effort will be required for production of standard equipment. Alloy steels have contributed many improvements in mining machinery, but their liberal use will be curtailed by substitution of the common metals more readily available.

Officials of the mining branch of WPB, headed by Dr. Wilbur A. Nelson, in charge of priorities orders P-56 and P-56-A, realize this action may mean a less effective service record of equipment, but it is one of the necessary sacrifices for getting an adequate flow of machinery to the mines that have a tremendous production task under way. Base-metal producers can help by ordering less scarce equipment wherever possible, filling out the required monthly inventory reports on time, and being tolerant in accepting substitution if the desired specifications cannot quickly be met. Foremen, shift bosses, and miners will direct more care to the daily use of equipment, and welding will be more widely used in repairing and building up worn parts, than ever before.

Fortunately for the mining industry, its priorities control was set up well in advance of the enemy action at Pearl Harbor. Operation of the controls is working very satisfactorily. Obviously, Washington officials view the mining industry as a vital part of the war effort; therefore, manufacturers and mine operators can feel assured that raw materials and mining supplies respectively will be shipped to them as occasion demands.

Mine operators are rapidly preparing to report new production records and as the pace quickens, manufacturers have their 1941 achievements available, which are herewith briefly described.

ROCK DRILLS — Refinements in rock drills advanced in 1941, but in most cases full advantage of new designs could not be gained because priorities curtailed the use of important alloys. Among the drifter drills, Gardner Denver Co., Quincy, Ill., reduced the vibration in its CF89H continuous-feed drifter promoting greater drilling speed. A slowly moving piston motor — approximately 30 strokes to each 12 in. of drill travel— is a feature reported to contribute long life and low air consumption of the drill.

The Independent Pneumatic Tool Co., Chicago, Ill., introduced its new Thor Model 82 drifter having a cylinder bore of 3 in. and Model 92 with a 3½-in. bore. These machines have a simple valve design which is said to render them free from functional troubles, and a cushion of air is provided at each end of the cylinder, thereby maintaining a minimum of vibration.

Chicago Pneumatic Tool Co., New York, N. Y., brought out its CP-44 self-rotating stoper, a medium-weight machine (123 lb.) recommended by the manufacturer for drilling in abrasive and seamy formations where heavy piston blows and strong rotation are required.

Sullivan Machinery Co., Michigan City, Ind., announced a new dual-valve 3½-in. bore drifter and two of the company's stoper drills offered improvements. The company's Safe-T stoper was featured with a new and larger feed leg.

Cleveland Rock Drill Co., Cleveland, Ohio, introduced a unique drill supporting mechanism called its Model MDR mining machine. The rig is designed to take care of one, two, or three drifters that can accurately and quickly place the drifters in the proper position for angle drilling. The unit can be mounted on ordinary mine car trucks.

Ingersoll-Rand Co., Phillipsburg, N. J., announced its new D-505 "Tunnel-IR" drill designed for heavy-duty work in hardrock. The company also brought out its hand-operated stoper, the HR48, and the 45-lb., JB-4, and 55-lb. JB-5 Jackhammers.

DIAMOND DRILLING — Acceptance by the industry of small, lightweight diamond-core drills that are also utilized for blast-hole drilling was demonstrated by the introduction of another type drill for this purpose. Chicago Pneumatic Tool Co., New York, N. Y., announced its new CP No. 5 diamond-core drill intended primarily for short-hole prospecting to a depth of 500 ft., but equally well for blast-hole drilling in drifts and stopes where conditions permit. Rods of E and EX fitting can be used with the company's impregnated bortz bits. The weight of the machine is 160 lb. (250 lb. with rod puller) and it has a high torque and a vibrationless air motor of rotary type. Bit speed is up to 1,500 r.p.m.

The electric drill of the Sullivan Machinery Co., Michigan City, Ind., brought out in 1940, employing impregnated Koebelite bortz bits, is reported finding wider use in the industry with its latest improvements.

E. J. Longyear Co., Minneapolis, Minn., introduced in 1941 its new Gopher air-driven diamond drill for both core and underground blast-hole drilling. The machine is powered by a 9-hp. rotary vane type air motor with speeds up to 3,500 r.p.m. Features listed by the manufacturer are the feed screw and the air motor, which form a structural unit. The quill and feed screw are driven directly by the motor through a set of spur gears which replace the usual bevel gears. Two models are available; No. 30, drilling 250 ft. at a bit speed of 3,000 r.p.m., and Model 15 which has a capacity of 500 ft. at a bit speed of 1,500 r.p.m. Core ⅞-in. in diameter can be recovered by both machines, and with an adaptor coupling, blast holes 1⅝ in. or 1½ in. in diameter can be drilled 100 ft. or more.

Sullivan Machinery Co., Michigan City, Ind., announced its new heavy-duty core drill, the 27-HD, adaptable for mineral prospecting. The built-in clutch allows the use of any power

unit having a stub shaft (electric, gasoline, or diesel), and the machine is rated at 1,750-ft. capacity with "E" rods.

AIR COMPRESSORS — Gardner-Denver Co., Quincy, Ill., added three larger sizes to its line of "HA" synchronous motor-driven, two-stage, horizontal air compressors. These large units are furnished with five-step control that automatically regulates the capacity of the compressor in five approximately equal steps.

Ingersoll-Rand Co., Phillipsburgh, N. J., announced in 1941 a new line of portable gasoline or oil-operated air compressors, claiming to reduce fuel costs up to 40 percent compared with previous I-R models. The machines are known as the "Mobil-Air" line.

Schramm, Inc., West Chester, Pa., announced an addition to its line of compressors. Its new engine drive-in line compressors are built in sizes ranging from 120- to 600-cu.ft. displacement and are available for those applications not reached by electric power service or where gasoline, oil, distillate, or diesel power units are preferred as a driving medium.

MECHANICAL LOADING — The urgent demand for base metals required a greater use of underground mechanical loading machines. Manufacturers were pressed to fill orders and apparently the various features of their 1940 machines remained virtually unchanged in 1941. Two improvements, however, were announced by the Eimco Corporation to its Tunneloader introduced late in 1940. A separately powered self-locking worm-and-gear mechanism was made for swinging the upper deck assembly to or from any desired digging position. The other was the elimination of any need for "centering" the upper deck assembly before dumping. This advantage was made by making a hopper into which the bucket discharges direct from any digging position. The material being loaded then moves on a conveyor belt that dumps into cars.

Goodman Mfg. Co., Chicago, Ill., added to its line of mucking machines the Type 125 Conway shovel, designed primarily for use when driving drifts in metal and non-metallic mines where clearances are limited. This loader is said to handle heavy materials quickly without risk of derailment. The unit has the Conway principle of conveying material to the cars by a rear conveyor instead of throwing it into the cars. The unit is available in track gages ranging from 18 in. to 42 in. and may be equipped with an air or electric motor.

Sullivan Machinery Co., Michigan City, Ind., announced a new 250-lb. portable two drum scraper-hauler designated as the "Portage S-2." The unit is interchangeable with electric or "Turbinair" motor.

SHAKER CONVEYORS—A wider acceptance of the shaker conveyors in metal mining where conditions are suitable for such equipment is an important trend in the industry toward mechanical mining. Goodman Manufacturing Co., Chicago, Ill., reports its shaker conveyors have been successfully demonstrated in metal mines in the past few years, in Southwestern copper mines for transferring ore from finger raises to main ore chutes and to haulage levels, and for transporting and distributing waste for back filling stopes. Advantage of shaker units in metal mines is an ability to move heavy loads continuously; also such units permit the use of small drifts; reduce time losses for timber repair to a minimum; require no full-time operator, and have a low maintenance cost. Installations in the Lake Superior iron-ore region have been found to be an efficient means of transporting ore broken in the top-slicing mining method.

HAULAGE—Wear and tear on haulage equipment was heavy in 1941, as ore production reached new records and the prospect ahead for 1942 convinces operators that replacement and building up of worn parts of welding will be more extensive than heretofore.

New ore-haulage equipment was limited during the year, but of interest to the small metal and non-metallic producers was the 1.5-ton storage-battery locomotive announced by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The locomotive is operated by a 5-hp. 40-v. d-c traction motor. The rated drawbar pull is 400 lb. and brake operation is by a handle set at an angle to permit maximum braking. The company also made nine 125-ton 1,520-hp. combination battery electric locomotives, the largest ever built for open-pit mining for the new Morenci mine of the Phelps Dodge Corporation in Arizona. They run on standard-gauge track operating off an 825-v. overhead trolley on the switchbacks and the main line. At the loading benches transition is made to Exide battery operation. Batteries are charged automatically during operation off the trolley.

General Electric Co., Bridgeport, Conn., announced a fan-cooled copper-oxide battery charger for 12 to 15 or 18-cell industrial truck lead batteries or 16 to 24 cell Edison type batteries. The device operates with a high starting rate which is reduced automatically to a safe finishing rate when the battery reaches approximately 80 to 85 percent of complete charge. These batteries occupy less than three feet of floor space, require no base bolts, and can be readily transferred.

Portable Lamp & Equipment Co., Pittsburgh, Pa., brought out in 1941 a car holder intended for holding cars on grades, which is employed by merely being placed on the rail, as no bolts or spikes are required. A rail splicer used for making a smooth connection between two rails of different sizes, without the use of offset plates or step chairs, was also announced.

CRUSHING AND GRINDING — Manufacturers of this type of equipment are preparing for one of their busiest periods in history. Equipment has virtually become standardized in design for the duration, but some mining companies are exploring the feasibility of larger crushing capacity in increasing production programs.

Nordberg Mfg. Co., Milwaukee, Wis., reported the adoption of short manganese to its Symons short-head cone crushers. Use of the short manganese reduces the finishing zone so that one finishing impact is delivered, thereby reducing the tendency for packing with ores containing a limited amount of contained moisture when crushing to $\frac{5}{16}$ in. or $\frac{1}{4}$ in. This type of manganese is not applicable in every crushing problem, as it depends on the size of the feed, size of finished product desired, and characteristics of the material to be crushed. Advantages of this development as mentioned by the manufacturer are lower liner costs, less power required, increased tonnage of finished product with a reduction of the circulating load, and stresses in the machine are reduced when material has a tendency to pack.

A 60-in. gyratory crusher that will break about 1,600 tons of ore per hour was manufactured by the Traylor Engineering & Mfg. Co., Allentown, Pa., for the new Morenci mill of the Phelps Dodge Corporation. The unit is considered the heaviest cast-steel crusher ever built, weighing around 1,000,000 lb. and requiring a 500-hp. motor for operation.

Allis-Chalmers Mfg. Co., Milwaukee, Wis., redesigned its No. 189 and 2410 fine-reduction crushers that are now being offered exclusively with steel frames and swinging jaws. Among the manufacturer's larger units from 60x48 in. down to 36x20 in. is also found a departure from previous standards. They are either built with one-piece welded frames or are made with a composite frame consisting of welded-steel side members and cast-steel front and back members. The pitmans and swing jaws are cast steel and automatic lubrication is provided for most of these crushers.

Among grinding equipment is the new type rod mill announced by the company now installed at a New York unit of the Republic Steel Corporation. The mill is 9 ft. in diameter and 16 ft. long. It is fed from both ends and discharges through a series of peripheral ports at the center-line of the mill. The mill dry-grinds magnetic iron ore from $\frac{3}{4}$ in. to 10 mesh. This unit is reported to replace three sets of large crushing rolls.

Mine Equipment

The Mine & Smelter Supply Co., Denver, Colo., reported an increasing use of its Marcy ball mills featuring its low pulp line principle. A number of the company's 10x10-ft. mills said to constitute one of the largest installations ever made in this country was completed for the new mill of the Phelps Dodge Corporation. These units receive a coarse feed, about ¾ in., and in a single stage grind to 65 mesh in closed circuit for flotation.

Denver Equipment Co. announced a new line of anti-friction type jaw crushers from 9x12 in. to 15x36 in. with the crusher bed made of one-piece electric steel casting, heavily reinforced. Crusher jaws are of manganese steel or a special wear-resisting chrome alloy-steel, and the eccentric shaft is of forged alloy heat-treated steel.

Universal Crusher Co., Cedar Rapids, Iowa, brought out what it called a "Two-in-One" crusher roll unit. The rolls are of the same over-all dimensions but are made in two sections mounted on a common shaft, with one section being ¾ in. smaller in diameter than the other section. There is a partition between the two roll sections and each is fed by a separate chute from the screen deck. This arrangement provides two steps of reduction where only one existed before.

Straub Mfg. Co., Oakland, Calif., announced a new line of ball mills known as the "Champion" Rib-cone ball mills. Six models are offered, some of which can be converted to longer length if increased capacity is desired. Liners are of maganese steel having the manufacturer's patented spiral lifter ribs. Mill sizes range from 4x3 ft. to 5x8 ft.

In the field of crusher lubrication, Kennedy Van Saun Mfg. & Engineering Corp., New York, N. Y., announced in 1941 a new oiling system for its gyratory crusher. One of the features is to have the oil under pressure entering the crusher at the bottom of the shaft and then forced up through the bearing surface between the main shaft and the ball for eccentric. It then spills out over the top of the ball and returns through the eccentric to the chamber in the bottom driving disk.

The Pennsylvania Crusher Co., Philadelphia, Pa., improved its impact crusher that performs its work by high velocity impact-batting driving the feed against a series of adjustable anvils that have working clearances varying from 3 to 6 in.

CLASSIFIERS—Closer control of the product in large settling areas, and designed for very large capacities, marked an improvement made to the Hydro-Classifier of the Hardinge Co., York, Pa. The machine is operated by a motor through an inclosed oil-lubricated drive gear and includes the Hardinge "auto-raise" to prevent damage from sudden overloads.

The Deister Concentrator Co., Fort Wayne, Ind., developed a new model of its SO Concenco constriction plate classifier which is primarily intended for the hydraulic classification of table feeds but which may be also used for certain fine-sizing operations. This new model has a deeper sorting column and an adjustable side, and end overflow weirs are provided. The orifice discharge assembly has been redesigned for greater efficiency and hand holes provide quick and easy access into the clear-water pressure chambers. The company's super-duty diagonal-deck concentrating table was reported improved and applied for commercial service in the separation of phosphate and sand.

A light-duty paddle-type log washer designed for the small operator was announced by the Eagle Iron Works, Des Moines, Iowa. The machine is made in five sizes in single- and double-screw types and features its patented design of water inflow at the bottom of the washer. The company also announced its new Eagle washer developed for the retention of fines.

CONVEYING—New items under this heading principally were of a small nature, such as the new rubber-tread return idler for belt conveyors introduced by Link-Belt Co., Chicago, Ill. The company also brought out a rubber-tread impact troughing idler and a self-aligning idler for flat-roll conveyor belts. For conveying of flowable granular, crushed, ground, or pulverized materials of a non-corrosive, non-abrasive nature, Link-Belt Co. introduced its Bulk-Flow conveyor, that employs a specially designed chain to which solid peak-top flights are rigidly attached to every pitch.

The Manhattan Rubber Mfg. Division, Passaic, N. J., introduced its new Homocord conveyor belt. This belt is said to combine the extreme flexibility of cord construction with the ability to hold metal fasteners to a degree previously approached only by fabric construction.

Pneumatic impact rollers for conveyors were announced by the Stephens-Adamson Mfg. Co., Aurora, Ill. They are for use under loading spouts and in belt feeders where the impact of heavy bulk loads subjects both conveyor belt and carrier to abnormal strains and wear.

WEIGHING—Hardinge Co., York, Pa., reports refinements in its Constant Weight Feeder, now known as the "Feedometer." It is now possible to adjust the unit and employ recording equipment that will feed by weight and record the rate of feed, as well as the weight fed simultaneously.

SCREENS—This type of equipment in the metal and non-metallic mining industry is being called upon to serve in a greater capacity demanded by the refinements in ore-dressing technique. Among the latest equipment of this type offered is the heavy-duty Plat-O vibrating screen of the Deister Machine Co., Fort Wayne, Ind., offered in single to multiple decks in a wide range of sizes. Leading features pointed out by the manufacturer include only two heavy-duty SKF spherical-roller self-aligning bearings running in oil. The screen cloth is automatically held under uniform tension and any one screening surface can be changed without disturbing remaining decks. The company also announced improvements in its Deister Plat-O ore-concentrating table.

A screen described as applying floating circle motion and known as the Denver-Dillon vibrating screen was announced by the Denver Equipment Co., Denver, Colo. It consists of a screen body eccentrically mounted on a concentrically rotatable shaft and carried on from spring-cushioned rubber-insulated suspended rods, which relieve the shaft and bearings of load and strain. This new unit is available in many sizes with screenings down to 20 mesh and lower if desired.

FLOTATION—During the past few years great strides have been made in the design and application of new equipment used in recovering metals and non-metallics by the flotation process. Flotation is playing a very important rôle in the recovery of strategic minerals and non-metallics. Methods studied in laboratory pilot plants by private companies and the Bureau of Mines are now being successfully employed in commercial production on an increasing scale. The sink-and-float process found a wider application in the preliminary concentration of metallic and non-metallic ores.

The metallurgical division of the Galigher Co., Salt Lake City, Utah, further developed its Agitair countercurrent froth flow system that provides froth removal at one or more points, usually, however, at the head cell in a given series. The company in 1941 added the No. 15 Agitair flotation machine to its line used in the recovery of manganese, tungsten and treatment of other ores.

JIGS—Manufacturers of jigs found the application of their machine increased greatly during the year as their usefulness established an important part in the recovery of manganese, chromite, fluorspar, tungsten, and other strategic and critical minerals. F. N. Bendelari, Joplin, Mo.,

announced improved draw cups in his machine having a selective and large drawing capacity.

A new wedge bar screen for ore preparation for use in jigs and screening was announced by the Wedge Bar Screen Corp., New York, N. Y.

MINERAL SEPARATION—Refinements and improvements were made in the high-intensity cobber magnetic pulleys of the Dings Magnetic Separator Co., Milwaukee, Wis. They are used almost exclusively for the cobbing of magnetite-ilmenite bearing ores and nickel ores. The company's Type K Crockett magnetic separator was improved as special water sprays were introduced for use on the finisher units that resulted in reduced quantities of water required. The feed mechanism of the separator was changed to allow for a more evenly distributed feed to the magnet, increasing the effectiveness of separation.

This company has the exclusive license to manufacture an iron detector device developed by Mr. Wurzbach, of Utah Copper Co. This device is stationed over moving conveyor belts. It will detect hidden bits of steel containing a high percentage of manganese. An electrical device connected with the detector will automatically ring a bell, and immediately stop the belt for manual removal of the tramp iron buried under the ore on the conveyor belt.

Magnetic Engineering & Mfg. Co., Clifton, N. J., announced a newly designed magnetic separator and ore concentrator designated as Type VT, built in various sizes ranging from the laboratory machine having a carrying tray 4 in. wide, to the largest unit having a tray 24 in. wide.

THICKENERS AND FILTERS—For small operations requiring filtering of table or flotation concentrates, or cyanide slimes totaling one to eight tons of concentrates per 24 hr., the Western Machinery Co., San Francisco, Calif., announced a new line of pan filters. Filtering action is provided by a vacuum and the pans are so arranged that a tilting motion will dislodge the cake from the cloth. Units are available in single and double pan in sizes 3x3 ft., 3x4 ft. and 4x4 ft.

T. Shriver & Co., Harrison, N. J., brought out a thickener announced as a modification of its standard plate and frame filter press in which parts of same size are interchangeable between these two machines. In the thickener the frames are designed not to permit filter cake to build up on the filter, as solids are continuously swept out of the unit in a stream of slurry which is progressively thickened. These units are said to eliminate the need for large tank capacity in continuous decantation and washing.

A low-head truss-type thickener with spiral rakes was announced by

Mine Equipment

Denver Equipment Co., Denver, Colo. The unit is said to incorporate a new principle of construction and the superstructures are furnished for thickeners from 45 to 75 ft. in diameter.

PUMPS — Gardner-Denver Co. Quincy, Ill., announced improved construction features of its line of centrifugal pumps. Byron Jackson Co., Los Angeles, Calif., reported a growing application of its submersible pumps for mine unwatering.

A new line of compact diaphragm pumps was announced by the Western Machinery Co., San Francisco, Calif. Capacity of the units, available from 2, 4, 5, and 6 in. is adjustable while in operation, through an eccentric regulator, which increases or decreases the length of stroke. Simplex, duplex, triplex, and quadruplex types are offered.

Vertical sand pumps in 3- and 4-in. sizes were announced by the Denver Equipment Co., designed to meet a demand for larger capacity pumps of this type. The 3-in. pump has a capacity at 25 percent solids of 225 g.p.m. and the 4-in. pump 450 g.p.m.

Pomona Pump Co., Pomona, Calif., announced an interesting improvement described as a diffusion "Vane Shape" that is said to increase the efficiency of its line of vertical pumps by 10 percent. The company discovered that the efficiency of a turbine pump could be increased materially by forming the ends of the diffuser vanes of a "bulbous" shape instead of the knife-edged vanes. The bulbous end acts to fill the void which forms on the impact of the fluid against the advanced end, and by being recessive at the rear of the rounded entrance edge, prevents pressure being applied by the fluid against the vane at the rear of the advanced edge.

Oliver United Filters, Inc., New York, N. Y. announced a new diaphragm slurry pump having the feature of being actuated without mechanical linkage or other mechanical connections to the diaphragm.

Ingersoll-Rand Co., Phillipsburg, N. J., added three new pumps to its line, the high-speed VHT for heads 25 to 3,400 ft. and its mixed-flow vertical pump for heads up to 45 ft., and high capacities. The RT pump, ranging from 150 to 2,200 g.p.m. and heads 460 to 3,150, was also brought out.

Victor Equipment Co., San Francisco, Calif., announced its new line of "100 R" rubber-lined sand and tailings pumps from $1\frac{1}{4}$ to $2\frac{1}{2}$ in. size.

EXCAVATORS — Equipment for earth-moving remained virtually unchanged during 1941, but more units for stripping, exacavation, and general earth-moving were reported employed in the mining industry than ever before. Manufacturers have made cost studies on various types of mining operations where such equipment can be used, and the fact that many operations are mining much deeper by the tractor-scraper methods indicates a trend in the growing application of this type of equipment.

Among new or improved pieces was the Model DLS Carryall Scraper of the R. G. Letourneau, Inc., Peoria, Ill. It has a rated capacity of $8\frac{1}{2}$ cu.yd. struck and 11 heaped yards for use with a new Caterpillar four-wheel tractor. A new lightweight $\frac{3}{4}$-cu. yd. convertible, shovel-dragline-crane Model 75 was announced by Link-Belt Co., Chicago, Ill.

Heavy wear on dipper teeth has been studied and some new designs have been developed. The American Manganese Steel Division of The American Brake Shoe & Foundry Co., Chicago Heights, Ill. introduced its No. R525 forged welded tooth consisting of two "halves" forged of nickel-chromium alloy rolled steel and welded together. Another new tooth by this company is its point having a box-like shank that fits into the base nose for security of attachment. This type tooth is for use in loose highly abrasive material where an all-cast-manganese steel tooth might not attain sufficient cold-working to acquire its characteristic surface hardness under impact. A third tooth, improved by the company, is its C-152, having the entire upper and lower faces ribbed or fluted.

A new $3\frac{1}{2}$-cu.yd. power shovel was announced by Lima Locomotive Works, Lima, Ohio, that is convertible to dragline or crane. The boom is 26 ft. and the dipper handle 19 ft. 6 in., and both are electrically welded throughout. The company also brought out a $1\frac{1}{2}$-cu.yd. combination shovel designated as Type 603.

Various minor improvements were reported made by Sauerman Bros., Chicago, Ill., to its line of drag scrapers. A new line of Crescent scraper buckets of molded design and lighter in weight was introduced by the company in 1941. A new type of seal for the company's Durolite wire rope blocks was also developed.

Among new equipment introduced by Caterpillar Tractor Co., Peoria, Ill., in 1941 was a 55-hp. diesel tractor designed to meet today's requirements of speed and capacity without increased operating costs. A rubber-tired industrial tractor, the DW-10, powered by a 90-hp. diesel engine and capable of hauling more than 13 tons of earth at 18 miles per hour was also announced. The company also built an 11-cu.yd. bottom-dump, pneumatic-tired wagon to go with this new unit. Hydraulic scrapers especially designed for this machine and manufactured

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E & M J METAL PRICES FOR 1941 • BY DAYS

Including Monthly Highs and Lows and Monthly Averages

JANUARY

Jan.	Copper, Electrolytic Domestic	Copper, Electrolytic Export	Tin, Straits, New York	Lead, Common, New York	Silver, New York	Zinc, Prime Western E. St. Louis
2	11.800	10.200	50.100	5.50	34.750	7.25
3	11.900	10.200	50.100	5.50	34.750	7.25
4	11.775	10.100	50.100	5.50	.....	7.25
6	11.850	10.200	50.100	5.50	34.750	7.25
7	11.800	10.175	50.100	5.50	34.750	7.25
8	11.775	10.125	50.100	5.50	34.750	7.25
9	11.775	10.200	50.100	5.50	34.750	7.25
10	11.950	10.200	50.100	5.50	34.750	7.25
11	11.775	10.125	50.100	5.50	.....	7.25
13	11.800	10.150	50.100	5.50	34.750	7.25
14	11.775	10.150	50.100	5.50	34.750	7.25
15	11.775	10.175	50.100	5.50	34.750	7.25
16	11.805	10.450	50.150	5.50	34.750	7.25
17	11.860	10.450	50.150	5.50	34.750	7.25
18	11.860	10.200	50.150	5.50	.....	7.25
20	11.925	10.225	50.150	5.50	34.750	7.25
21	11.900	10.200	50.150	5.50	34.750	7.25
22	11.775	10.325	50.150	5.50	34.750	7.25
23	11.850	10.375	50.150	5.50	34.750	7.25
24	11.825	10.200	50.200	5.50	34.750	7.25
25	11.775	10.325	50.200	5.50	.....	7.25
27	11.825	10.325	50.200	5.50	34.750	7.25
28	11.775	10.450	50.200	5.50	34.750	7.25
29	11.775	10.450	50.200	5.50	34.750	7.25
30	11.825	10.375	50.250	5.50	34.750	7.25
31	11.775	10.325	50.500	5.50	34.750	7.25
High	**11.950**	**10.450**	**50.500**	**5.500**	**34.750**	**7.250**
Low	**11.775**	**10.100**	**50.100**	**5.500**	**34.750**	**7.250**
Average	**11.819**	**10.257**	**50.154**	**5.500**	**34.750**	**7.250**

FEBRUARY

Feb.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	11.775	10.325	50.500	5.50	.....	7.25
3	11.800	10.325	50.350	5.50	34.750	7.25
4	11.775	10.325	50.350	5.50	34.750	7.25
5	11.775	10.350	50.350	5.50	34.750	7.25
6	11.800	10.450	50.350	5.50	34.750	7.25
7	11.775	10.450	50.250	5.50	34.750	7.25
8	11.775	10.425	50.250	5.50	.....	7.25
10	11.825	10.450	50.250	5.65	34.750	7.25
11	11.775	10.450	50.250	5.65	34.750	7.25
12	Holiday	10.450	Holiday	Holiday	Holiday	Holiday
13	11.775	10.450	50.625	5.65	34.750	7.25
14	11.825	10.450	51.000	5.65	34.750	7.25
15	11.775	10.450	51.125	5.65	.....	7.25
17	11.775	10.450	51.500	5.65	34.750	7.25
18	11.775	10.325	51.750	5.65	34.750	7.25
19	11.800	10.325	52.625	5.65	34.750	7.25
20	11.800	10.450	54.250	5.65	34.750	7.25
21	11.825	10.450	53.750	5.65	34.750	7.25
22	Holiday	10.450	Holiday	Holiday	Holiday	Holiday
24	11.825	10.450	53.125	5.65	34.750	7.25
25	11.875	10.325	52.000	5.65	34.750	7.25
26	11.800	10.450	51.375	5.65	34.750	7.25
27	11.775	10.450	51.175	5.65	34.750	7.25
28	11.775	10.450	51.250	5.65	34.750	7.25
High	**11.875**	**10.450**	**54.250**	**5.650**	**34.750**	**7.250**
Low	**11.775**	**10.325**	**50.250**	**5.500**	**34.750**	**7.250**
Average	**11.794**	**10.414**	**51.293**	**5.602**	**34.750**	**7.250**

MARCH

Mar.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	11.775	10.475	51.250	5.65	.....	7.25
3	11.775	10.450	51.250	5.75	34.750	7.25
4	11.775	10.450	51.250	5.75	34.750	7.25
5	11.775	10.450	51.250	5.75	34.750	7.25
6	11.825	10.450	51.375	5.75	34.750	7.25
7	11.775	10.450	51.625	5.75	34.750	7.25
8	11.775	10.450	51.750	5.75	.....	7.25
10	11.775	10.450	52.000	5.75	34.750	7.25
11	11.800	10.500	51.750	5.75	34.750	7.25
12	11.775	10.450	51.875	5.75	34.750	7.25
13	11.875	10.550	52.000	5.75	34.750	7.25
14	11.825	10.550	52.000	5.75	34.750	7.25
15	11.825	10.550	52.125	5.75	.....	7.25
17	11.775	10.600	52.125	5.75	34.750	7.25
18	11.875	10.600	52.250	5.75	34.750	7.25
19	11.800	10.600	52.375	5.75	34.750	7.25
20	11.825	10.700	52.750	5.75	34.750	7.25
21	11.950	10.700	52.500	5.75	34.750	7.25
22	11.775	10.825	52.500	5.75	.....	7.25
24	11.800	10.825	52.500	5.75	34.750	7.25
25	11.825	10.700	52.500	5.75	34.750	7.25
26	11.850	10.575	52.625	5.85	34.750	7.25
27	11.850	10.700	52.625	5.85	34.750	7.25
28	11.875	10.825	52.750	5.85	34.750	7.25
29	11.800	10.825	52.625	5.85	.....	7.25
31	11.825	10.700	52.125	5.85	34.750	7.25
High	**11.950**	**10.825**	**52.750**	**5.850**	**34.750**	**7.250**
Low	**11.775**	**10.450**	**51.250**	**5.650**	**34.750**	**7.250**
Average	**11.814**	**10.592**	**52.067**	**5.765**	**34.750**	**7.250**

APRIL

April	Copper, Electrolytic Domestic	Copper, Electrolytic Export	Tin, Straits, New York	Lead, Common, New York	Silver, New York	Zinc, Prime Western E. St. Louis
1	11.800	10.950	51.625	5.85	34.750	7.25
2	11.800	10.950	51.500	5.85	34.750	7.25
3	11.925	10.900	51.625	5.85	34.750	7.25
4	11.900	10.950	51.750	5.85	34.750	7.25
5	11.850	11.000	51.750	5.85	.....	7.25
7	11.875	10.950	51.750	5.85	34.750	7.25
8	11.825	10.950	51.625	5.85	34.750	7.25
9	11.825	10.950	51.625	5.85	34.750	7.25
10	11.775	10.950	51.750	5.85	34.750	7.25
11	11.850	10.950	52.000	5.85	34.750	7.25
12	11.850	10.950	52.000	5.85	.....	7.25
14	11.825	10.950	52.000	5.85	34.750	7.25
15	11.775	10.950	52.000	5.85	34.750	7.25
16	11.775	10.950	52.375	5.85	34.750	7.25
17	11.775	10.950	52.250	5.85	34.750	7.25
18	11.775	10.950	52.250	5.85	34.750	7.25
19	11.850	10.950	52.500	5.85	.....	7.25
21	11.775	10.950	52.500	5.85	34.750	7.25
22	11.775	10.950	52.375	5.85	34.750	7.25
23	11.850	10.950	52.375	5.85	34.750	7.25
24	11.775	10.950	52.250	5.85	34.750	7.25
25	11.850	10.950	52.125	5.85	34.750	7.25
26	11.900	10.950	52.000	5.85	.....	7.25
28	11.775	11.000	51.750	5.85	34.750	7.25
29	11.775	10.950	51.750	5.85	34.750	7.25
30	11.800	10.950	52.000	5.85	34.750	7.25
High	**11.925**	**11.000**	**52.500**	**5.850**	**34.750**	**7.250**
Low	**11.775**	**10.900**	**51.500**	**5.850**	**34.750**	**7.250**
Average	**11.820**	**10.952**	**51.981**	**5.850**	**34.750**	**7.250**

MAY

May	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	11.775	10.950	52.000	5.85	34.750	7.25
2	11.825	10.950	52.125	5.85	34.750	7.25
3	11.775	10.950	51.750	5.85	.....	7.25
5	11.825	10.950	51.875	5.85	34.750	7.25
6	11.900	10.950	52.000	5.85	34.750	7.25
7	11.775	10.950	52.375	5.85	34.750	7.25
8	11.825	10.950	52.125	5.85	34.750	7.25
9	11.800	10.950	52.250	5.85	34.750	7.25
10	11.825	10.950	52.250	5.85	.....	7.25
12	11.775	10.950	52.125	5.85	34.750	7.25
13	11.800	10.950	52.125	5.85	34.750	7.25
14	11.800	10.950	52.125	5.85	34.750	7.25
15	11.825	10.950	52.250	5.85	34.750	7.25
16	11.825	10.950	52.250	5.85	34.750	7.25
17	11.775	10.950	52.250	5.85	.....	7.25
19	11.775	10.950	52.250	5.85	34.750	7.25
20	11.900	10.950	52.250	5.85	34.750	7.25
21	11.800	10.950	52.375	5.85	34.750	7.25
22	11.850	10.950	52.250	5.85	34.750	7.25
23	11.875	10.950	52.250	5.85	34.750	7.25
24	11.775	10.950	52.125	5.85	.....	7.25
26	11.800	10.950	52.200	5.85	34.750	7.25
27	11.825	10.950	52.125	5.85	34.750	7.25
28	11.775	10.950	52.250	5.85	34.750	7.25
29	11.925	10.950	52.125	5.85	34.750	7.25
30	Holiday	10.950	Holiday	Holiday	Holiday	Holiday
31	11.775	10.950	52.250	5.85	.....	7.25
High	**11.925**	**10.950**	**52.375**	**5.850**	**34.750**	**7.250**
Low	**11.775**	**10.950**	**51.750**	**5.850**	**34.750**	**7.250**
Average	**11.815**	**10.950**	**52.166**	**5.850**	**34.750**	**7.250**

JUNE

June	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
2	11.775	10.950	52.125	5.85	34.750	7.25
3	11.800	10.950	52.125	5.85	34.750	7.25
4	11.800	10.950	52.250	5.85	34.750	7.25
5	11.825	10.950	52.250	5.85	34.750	7.25
6	11.775	10.950	52.750	5.85	34.750	7.25
7	11.775	10.950	52.875	5.85	.....	7.25
9	11.800	10.950	53.125	5.85	34.750	7.25
10	11.875	10.950	52.875	5.85	34.750	7.25
11	11.775	10.950	53.000	5.85	34.750	7.25
12	11.775	10.950	52.875	5.85	34.750	7.25
13	11.875	10.950	52.375	5.85	34.750	7.25
14	11.775	10.950	52.000	5.85	.....	7.25
16	11.800	10.950	52.250	5.85	34.750	7.25
17	11.950	10.950	52.375	5.85	34.750	7.25
18	11.800	10.950	52.625	5.85	34.750	7.25
19	11.800	10.950	52.875	5.85	34.750	7.25
20	11.850	10.950	53.000	5.85	34.750	7.25
21	11.775	10.950	53.125	5.85	.....	7.25
23	11.900	10.950	53.000	5.85	34.750	7.25
24	11.800	10.950	52.750	5.85	34.750	7.25
25	11.775	10.950	53.000	5.85	34.750	7.25
26	11.775	10.950	52.875	5.85	34.750	7.25
27	11.825	10.950	52.875	5.85	34.750	7.25
28	11.775	10.950	52.875	5.85	.....	7.25
30	11.800	10.950	52.875	5.85	34.750	7.25
High	**11.950**	**10.950**	**53.125**	**5.850**	**34.750**	**7.250**
Low	**11.775**	**10.950**	**52.000**	**5.850**	**34.750**	**7.250**
Average	**11.810**	**10.950**	**52.685**	**5.850**	**34.750**	**7.250**

E & M J METAL PRICES FOR 1941 • BY DAYS

Including Monthly Highs and Lows and Monthly Averages

JULY

July	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	11.825	10.950	52.750	5.85	34.750	7.25
2	11.800	10.950	52.750	5.85	34.750	7.25
3	11.825	10.950	52.875	5.85	34.750	7.25
4	Holiday	10.950	Holiday	Holiday	Holiday	Holiday
5	11.775	10.950	53.000	5.85	.....	7.25
7	11.800	10.950	53.000	5.85	34.750	7.25
8	11.850	10.950	53.000	5.85	34.750	7.25
9	11.800	10.950	53.250	5.85	34.750	7.25
10	11.775	10.950	53.250	5.85	34.750	7.25
11	11.775	10.950	53.375	5.85	34.750	7.25
12	11.775	10.950	53.625	5.85	.....	7.25
14	11.825	10.950	53.625	5.85	34.750	7.25
15	11.800	10.950	53.375	5.85	34.750	7.25
16	11.775	10.950	53.375	5.85	34.750	7.25
17	11.900	10.950	53.250	5.85	34.750	7.25
18	11.875	10.950	53.375	5.85	34.750	7.25
19	11.775	10.950	53.375	5.85	.....	7.25
21	11.825	10.950	53.375	5.85	34.750	7.25
22	11.900	10.950	53.625	5.85	34.750	7.25
23	11.800	10.950	53.375	5.85	34.750	7.25
24	11.850	10.950	54.125	5.85	34.750	7.25
25	11.850	10.950	55.250	5.85	34.750	7.25
26	11.775	10.950	55.250	5.85	.....	7.25
28	11.800	10.950	55.000	5.85	34.750	7.25
29	11.775	10.950	54.000	5.85	34.750	7.25
30	11.775	10.950	53.000	5.85	34.750	7.25
31	11.800	10.950	52.250	5.85	34.750	7.25
High	**11.900**	**10.950**	**55.250**	**5.850**	**34.750**	**7.250**
Low	**11.775**	**10.950**	**52.250**	**5.850**	**34.750**	**7.250**
Average	**11.812**	**10.950**	**53.481**	**5.850**	**34.750**	**7.250**

AUGUST

Aug.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	11.800	10.950	52.750	5.85	34.750	7.25
2	11.775	10.950	52.750	5.85	.....	7.25
4	11.800	10.950	52.750	5.85	34.750	7.25
5	11.800	10.950	52.125	5.85	34.750	7.25
6	11.775	10.950	52.250	5.85	34.750	7.25
7	11.775	10.950	52.875	5.85	34.750	7.25
8	11.775	10.950	53.000	5.85	34.750	7.25
9	11.775	10.950	53.000	5.85	.....	7.25
11	11.775	10.950	53.000	5.85	34.750	7.25
12	11.775	10.950	53.000	5.85	34.750	7.25
13	11.775	10.950	53.000	5.85	34.750	7.25
14	11.775	10.950	53.000	5.85	34.750	7.25
15	11.775	10.950	52.500	5.85	34.750	7.25
16	11.775	10.950	52.000	5.85	.....	7.25
18	11.775	10.950	52.000	5.85	34.750	7.25
19	11.775	10.950	52.000	5.85	34.750	7.25
20	11.775	10.950	52.000	5.85	34.750	7.25
21	11.775	10.950	52.000	5.85	34.750	7.25
22	11.775	10.950	52.000	5.85	34.750	7.25
23	11.775	10.950	52.000	5.85	.....	7.25
25	11.775	10.950	52.000	5.85	34.750	7.25
26	11.775	10.950	52.000	5.85	34.750	7.25
27	11.775	10.950	52.000	5.85	34.750	7.25
28	11.775	10.950	52.000	5.85	34.750	7.25
29	11.775	10.950	52.000	5.85	34.750	7.25
30	11.775	10.950	52.000	5.85	.....	7.25
High	**11.800**	**10.950**	**53.000**	**5.850**	**34.750**	**7.250**
Low	**11.775**	**10.950**	**52.000**	**5.850**	**34.750**	**7.250**
Average	**11.778**	**10.950**	**52.385**	**5.850**	**34.750**	**7.250**

SEPTEMBER

Sept.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	Holiday	10.950	Holiday	Holiday	Holiday	Holiday
2	11.775	10.950	52.000	5.85	34.750	7.25
3	11.775	10.950	52.000	5.85	34.750	7.25
4	11.775	10.950	52.000	5.85	34.750	7.25
5	11.775	10.950	52.000	5.85	34.750	7.25
6	11.775	10.950	52.000	5.85	.....	7.25
8	11.775	10.950	52.000	5.85	34.750	7.25
9	11.775	10.950	52.000	5.85	34.750	7.25
10	11.775	10.950	52.000	5.85	34.750	7.25
11	11.775	10.950	52.000	5.85	34.750	7.25
12	11.775	10.950	52.000	5.85	34.750	7.25
13	11.775	10.950	52.000	5.85	.....	7.25
15	11.775	10.950	52.000	5.85	34.750	7.25
16	11.775	10.950	52.000	5.85	34.750	7.25
17	11.775	10.950	52.000	5.85	34.750	7.25
18	11.775	10.950	52.000	5.85	34.750	7.25
19	11.775	10.950	52.000	5.85	34.750	7.25
20	11.775	10.950	52.000	5.85	.....	7.25
22	11.775	10.950	52.000	5.85	34.750	7.25
23	11.775	10.950	52.000	5.85	34.750	7.25
24	11.775	10.950	52.000	5.85	34.750	7.25
25	11.775	10.950	52.000	5.85	34.750	7.25
26	11.775	11.450	52.000	5.85	34.750	7.25
27	11.775	11.450	52.000	5.85	.....	7.25
29	11.775	11.450	52.000	5.85	34.750	7.25
30	11.775	11.450	52.000	5.85	34.750	7.25
High	**11.775**	**11.450**	**52.000**	**5.850**	**34.750**	**7.250**
Low	**11.775**	**10.950**	**52.000**	**5.850**	**34.750**	**7.250**
Average	**11.775**	**11.027**	**52.000**	**5.850**	**34.750**	**7.250**

OCTOBER

Oct.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	11.775	11.450	52.000	5.85	34.750	7.25
2	11.775	11.450	52.000	5.85	34.750	7.25
3	11.775	11.450	52.000	5.85	34.750	7.25
4	11.775	11.450	52.000	5.85	.....	7.25
6	11.775	11.450	52.000	5.85	34.750	7.25
7	11.775	11.450	52.000	5.85	34.750	7.25
8	11.775	11.450	52.000	5.85	34.750	7.25
9	11.775	11.450	52.000	5.85	34.750	7.25
10	11.775	11.450	52.000	5.85	34.750	8.25
11	11.775	11.450	52.000	5.85	.....	8.25
13	Holiday	11.450	Holiday	Holiday	Holiday	Holiday
14	11.775	11.450	52.000	5.85	34.750	8.25
15	11.775	11.450	52.000	5.85	34.750	8.25
16	11.775	11.450	52.000	5.85	34.750	8.25
17	11.775	11.450	52.000	5.85	34.750	8.25
18	11.775	11.450	52.000	5.85	.....	8.25
20	11.775	11.450	52.000	5.85	34.750	8.25
21	11.775	11.450	52.000	5.85	34.750	8.25
22	11.775	11.200	52.000	5.85	34.750	8.25
23	11.775	11.200	52.000	5.85	34.750	8.25
24	11.775	11.200	52.000	5.85	34.750	8.25
25	11.775	11.200	52.000	5.85	.....	8.25
27	11.775	11.200	52.000	5.85	34.750	8.25
28	11.775	11.200	52.000	5.85	34.750	8.25
29	11.775	11.200	52.000	5.85	34.750	8.25
30	11.775	11.200	52.000	5.85	34.750	8.25
31	11.775	11.200	52.000	5.85	34.750	8.25
High	**11.775**	**11.450**	**52.000**	**5.850**	**34.750**	**8.250**
Low	**11.775**	**11.200**	**52.000**	**5.850**	**34.750**	**7.250**
Average	**11.775**	**11.367**	**52.000**	**5.850**	**34.750**	**7.942**

NOVEMBER

Nov.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	11.775	11.200	52.000	5.85	.....	8.25
3	11.775	11.200	52.000	5.85	34.750	8.25
4	Holiday	11.200	Holiday	Holiday	Holiday	Holiday
5	11.775	11.200	52.000	5.85	34.750	8.25
6	11.775	11.200	52.000	5.85	34.750	8.25
7	11.775	11.200	52.000	5.85	34.750	8.25
8	11.775	11.200	52.000	5.85	.....	8.25
10	11.775	11.200	52.000	5.85	34.750	8.25
11	Holiday	11.200	Holiday	Holiday	Holiday	Holiday
12	11.775	11.200	52.000	5.85	34.750	8.25
13	11.775	11.200	52.000	5.85	34.750	8.25
14	11.775	11.200	52.000	5.85	34.750	8.25
15	11.775	11.200	52.000	5.85	.....	8.25
17	11.775	11.200	52.000	5.85	34.750	8.25
18	11.775	11.200	52.000	5.85	34.750	8.25
19	11.775	11.200	52.000	5.85	34.750	8.25
20	Holiday	11.200	Holiday	Holiday	Holiday	Holiday
21	11.775	11.200	52.000	5.85	34.750	8.25
22	11.775	11.200	52.000	5.85	Holiday	8.25
24	11.775	11.200	52.000	5.85	34.750	8.25
25	11.775	11.200	52.000	5.85	34.750	8.25
26	11.775	11.200	52.000	5.85	34.750	8.25
27	11.775	11.200	52.000	5.85	34.750	8.25
28	11.775	11.200	52.000	5.85	35.125	8.25
29	11.775	11.200	52.000	5.85	.....	8.25
High	**11.775**	**11.200**	**52.000**	**5.850**	**35.125**	**8.250**
Low	**11.775**	**11.200**	**52.000**	**5.850**	**34.750**	**8.250**
Average	**11.775**	**11.200**	**52.000**	**5.850**	**34.772**	**8.250**

DECEMBER

Dec.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	11.775	11.200	52.000	5.85	35.125	8.25
2	11.775	11.200	52.000	5.85	35.125	8.25
3	11.775	11.200	52.000	5.85	35.125	8.25
4	11.775	11.200	52.000	5.85	35.125	8.25
5	11.775	11.200	52.000	5.85	35.125	8.25
6	11.775	11.200	52.000	5.85	.....	8.25
8	11.775	11.200	52.000	5.85	35.125	8.25
9	11.775	11.200	52.000	5.85	35.125	8.25
10	11.775	11.200	52.000	5.85	35.125	8.25
11	11.775	11.200	52.000	5.85	35.125	8.25
12	11.775	11.200	52.000	5.85	35.125	8.25
13	11.775	11.200	52.000	5.85	.....	8.25
15	11.775	11.200	52.000	5.85	35.125	8.25
16	11.775	11.200	52.000	5.85	35.125	8.25
17	11.775	11.200	52.000	5.85	35.125	8.25
18	11.775	11.200	52.000	5.85	35.125	8.25
19	11.775	11.200	52.000	5.85	35.125	8.25
20	11.775	11.200	52.000	5.85	.....	8.25
22	11.775	11.200	52.000	5.85	35.125	8.25
23	11.775	11.200	52.000	5.85	35.125	8.25
24	11.775	11.200	52.000	5.85	35.125	8.25
25	Holiday	Holiday	Holiday	Holiday	Holiday	Holiday
26	11.775	11.200	52.000	5.85	35.125	8.25
27	11.775	11.200	52.000	5.85	.....	8.25
29	11.775	11.200	52.000	5.85	35.125	8.25
30	11.775	11.200	52.000	5.85	35.125	8.25
31	11.775	11.200	52.000	5.85	35.125	8.25
High	**11.775**	**11.200**	**52.000**	**5.850**	**35.125**	**8.250**
Low	**11.775**	**11.200**	**52.000**	**5.850**	**35.125**	**8.250**
Average	**11.775**	**11.200**	**52.000**	**5.850**	**35.125**	**8.250**

CURRENT METAL Statistics

MINE OPERATORS are anxiously waiting for Washington to announce on what basis the 1942 mine production quotas are to be determined so as to obtain the higher prices for metals. Meanwhile plans are being considered and studied for increasing output at many properties and reopening old base metal mines.

Metals Reserve has requested all producers to continue selling their ore and concentrates through regular channels in the ordinary way but should keep all data about production, sales and settlements for the affidavit required of them.

▶ ZINC — The domestic zinc statistics (all grades) for December and January, according to the American Zinc Institute, follow:

	Dec. 1941	Jan. 1942
Stock at beginning	23,182	24,062
Production	78,635	79,213
Total	101,817	103,275
Production daily rate	2,537	2,555
Shipments:		
Domestic	65,690	67,248
Foreign (drawback duty)	12,065	12,165
Total shipments	77,755	79,413
Unfilled orders	87,666	110,552
Stock at end	24,062	23,862

Production of Prime Western and other grades, follows:

Production by Grades		
Prime Western	31,005	30,396
Select	1,495	1,467
Brass Special	4,677	5,262
Intermediate	5,131	6,378
High Grade	17,787	18,135
Special High Grade	18,540	17,575
Total	78,635	79,213

▶ TIN—Deliveries of tin in the United States during 1941 totaled 143,342 long tons, which compares with 115,339 tons in 1940, the Commodity Exchange reports. Deliveries, by months, during the last three years, in long tons:

	1939	1940	1941
January	4,330	9,780	12,760
February	4,105	6,600	12,195
March	4,755	9,244	16,092
April	5,980	7,855	13,955
May	5,905	7,905	10,490
June	4,925	9,225	14,880
July	5,275	7,325	12,575
August	6,295	12,470	13,625
September	5,050	11,410	12,715
October	6,040	11,820	8,000
November	7,870	12,505	8,355
December	11,366	9,200	7,700
Totals	71,896	115,339	143,342

▶ MOLYBDENUM—Production of molybdenum concentrate in the United States during November was 3,758,200 lb. of molybdenum contained, against 3,918,900 lb. in October, according to the Bureau of Mines. Shipments during November totaled 4,458,600 lb. of which 1,104,500 lb. went for export. Stocks in the hands of producers at the end of November amounted to 17,902,600 lb., against 18,603,000 lb. a month previous.

▶ MANGANESE — Shipments of manganese ore (35 percent or more manganese, natural) from domestic mines are estimated at 76,000 long tons in 1941, compared with 40,123 tons in 1940, according to preliminary figures released by the Bureau of Mines.

Manganese ore was reported shipped from Alabama, Arizona, Arkansas, California, Colorado, Georgia, Idaho, Montana, Nevada, Oklahoma, Oregon, Tennessee, Utah, Virginia, Washington, and West Virginia. However, Arkansas, Montana, and Tennessee accounted for about 77 percent of the total in 1941. There were no shipments from Puerto Rico in 1940 and 1941.

Shipments of ferruginous manganese ore (10 to 35 percent manganese, natural) from domestic mines are estimated at 459,000 long tons in 1941, compared with 320,006 tons in 1940. Ferruginous manganese ore was shipped from Alabama, Arizona, Arkansas, Georgia, Idaho, Massachusetts, Minnesota, Montana, Nevada, New Mexico, North Carolina, Oklahoma, Tennessee, Virginia, Washington, and West Virginia. New Mexico and Minnesota, however, contributed about 93 percent of the total in 1941.

Shipments of manganiferous iron ore (5 to 10 percent manganese, natural) from domestic mines are estimated at 820,000 long tons in 1941, compared with 816,541 tons in 1940. Manganiferous iron ore was shipped from Minnesota, and Nevada in 1941.

General imports of manganese ore containing 35 percent or more manganese during nine month ending Sept. 30, 1941, comprised 838,239 long tons of metallurgical ore, containing 393,741 tons of manganese; and 14,951 tons of battery-grade ore, containing 7,869 tons of manganese.

▶ LEAD—Production of lead refined in the United States during December amounted to 48,829 tons from domestic ore and 8,352 tons from foreign and secondary sources, a total of 57,181 tons. This compares with total production of 48,930 tons in November and a monthly average of 52,907 tons for all of 1941, according to the American Bureau of Metal Statistics. Figures for November and December, in tons, follow:

	Nov.	Dec.
Stock at beginning	10,735	13,671
Production:		
From domestic ore	41,566	48,829
Secondary and foreign	7,364	8,352
Totals	48,930	57,181
Domestic shipments	45,980	50,680
Stock at end	13,671	20,185

Statistics for 1940 and 1941, covering lead refined in the United States, in tons, follows:

	1940	1941
Stock at beginning	58,777	40,926
Production:		
From domestic ore	480,894	527,503
Secondary and foreign	104,586	107,385
Totals	585,480	634,888
Domestic shipments	603,143	655,542
Stock at end	40,926	20,185

U. S. Production of Gold and Silver in 1941

The Bureau of the Mint, with the cooperation of the Bureau of Mines, has issued the following statement of the preliminary estimate of refinery production of gold and silver in the United States during the calendar year 1941:

	Gold		Silver	
Location:	Ounces	(a) Value	Ounces	(a) Value
Continental United States	4,090,785	$143,177,475	67,855,209	$48,252,593
Alaska	703,522	24,623,270	233,253	165,869
Philippine Islands	1,161,210	40,642,350	1,244,176	884,747
Totals, 1941	5,955,517	208,443,095	69,332,638	49,303,209
Totals, 1940	6,003,105	210,108,700	69,585,734	49,483,189
Previous largest production	(b) 6,003,105	$210,108,700	(c) 74,961,075	$37,397,300

(a) Gold valued at $35.00 per fine ounce; silver valued in 1941 at $0.7111: the amount per fine ounce returned to depositors of newly mined domestic silver during 1941. (b) 1940. (c) 1915.

United States Copper Statistics

Following is a summary of the Copper Institute's statistics, in tons. Excepting deliveries, which since March, 1941, include copper imported and released by Metals Reserve Co., the figures pertain to duty-free metal.

	Production		Deliveries to Customers			(c) Stocks,
	(a) Crude	Refined	(b) Domestic	Export	Total	Refined
Year 1939	836,074	818,289	814,407	134,152	948,559	159,485
" 1940	992,293	1,033,710	1,001,886	48,537	1,050,423	142,772
" 1941	1,015,494	1,065,667	1,513,292	307	1,513,599	75,564
1941						
January	83,280	93,840	119,736	22	119,758	116,854
February	79,240	93,654	112,808	11	112,819	97,689
March	85,701	95,322	134,333	6	134,339	89,873
April	88,042	89,687	123,580	49	123,629	98,789
May	90,342	89,390	144,293	.....	144,293	93,076
June	82,558	88,560	115,097	42	115,139	98,164
July	82,099	86,879	143,089	33	143,122	74,384
August	84,695	85,426	117,486	.....	117,486	71,930
September	81,839	81,553	121,021	.....	121,021	63,670
October (d)	86,019	86,617	121,313	144	121,457	67,260
November (d)	84,718	84,799	123,168	.....	123,168	72,352
December	86,961	89,940	137,368	.....	137,368	75,564

(a) Mine or smelter production or shipments; and custom intake, including scrap. (b) Beginning March, 1941, includes delivery of duty paid foreign copper for domestic consumption. (c) At refineries, on consignment and in Exchange warehouses, but not including consumers' stocks at their plants or warehouses. (d) Corrected.

Summary of the

MARKETS

JANUARY witnessed several price changes and numerous official regulations designed to curb non-essential consumption of strategic metals. Outstanding in price revisions was an advance in lead of 65 points, to 6.50c., New York, that became effective on Jan. 13, shortly after Price Administrator Henderson announced that a higher quotation is in order to stimulate production. Export copper moved up one-half cent on Jan. 14, virtually raising the price paid for foreign metal by Metals Reserve to the full 12c. Connecticut Valley basis. Quicksilver advanced on limited offerings by producers, most of whom found themselves well sold up.

Conservation Orders were issued in Washington during January for tin, lead, nickel, aluminum, and quicksilver, sharply restricting the use of these metals on non-essentials. The magnitude of the war effort points to a tight situation in most strategic materials for a long time to come, notwithstanding the curbs on use now in force.

Need for more metals prompted officials of the Government to put a plan into operation that provides for what amounts to a premium on extra production (see page 107). The plan, however, will not disturb market prices for copper, lead, and zinc.

Metals Reserve purchased Chilean copper on the basis of 11.75c., f.a.s. New York. The deal covered January production and will probably be renewed for February on the same terms. All copper of foreign origin now finds a ready buyer in the Government's purchasing agency on even terms with those named for Chile. Privately imported copper (bonded metal) was placed under full priority control. Brass mills are being given first consideration in the domestic market, owing to expansion in production now coming into the picture. Consumers were warned by Chief Nelson of the War Production Board that any violations of the regulations restricting use of copper would be enforced. A nation-wide, plant-by-plant survey of some 90 primary fabricators of copper has been ordered to determine whether fabricators have been operating in compliance with priority orders.

The industry-government control of zinc was extended during January to

UNITED STATES MARKET

1942 Jan.	Electrolytic Copper: Domestic (a) Refinery	Electrolytic Copper: Export (b) Refinery	Straits Tin: New York	Lead: New York	Lead: St. Louis	Zinc: St. Louis
2	11.775	11.200	52.000	5.85	5.70	8.25
3	11.775	11.200	52.000	5.85	5.70	8.25
5	11.775	11.200	52.000	5.85	5.70	8.25
6	11.775	11.200	52.000	5.85	5.70	8.25
7	11.775	11.200	52.000	5.85	5.70	8.25
8	11.775	11.200	52.000	5.85	5.70	8.25
9	11.775	11.200	52.000	5.85	5.70	8.25
10	11.775	11.200	52.000	5.85	5.70	8.25
12	11.775	11.200	52.000	5.85	5.70	8.25
13	11.775	11.200	52.000	6.50	6.35	8.25
14	11.775	11.700	52.000	6.50	6.35	8.25
15	11.775	11.700	52.000	6.50	6.35	8.25
16	11.775	11.700	52.000	6.50	6.35	8.25
17	11.775	11.700	52.000	6.50	6.35	8.25
19	11.775	11.700	52.000	6.50	6.35	8.25
20	11.775	11.700	52.000	6.50	6.35	8.25
21	11.775	11.700	52.000	6.50	6.35	8.25
22	11.775	11.700	52.000	6.50	6.35	8.25
23	11.775	11.700	52.000	6.50	6.35	8.25
24	11.775	11.700	52.000	6.50	6.35	8.25
26	11.775	11.700	52.000	6.50	6.35	8.25
27	11.775	11.700	52.000	6.50	6.35	8.25
28	11.775	11.700	52.000	6.50	6.35	8.25
29	11.775	11.700	52.000	6.50	6.35	8.25
30	11.775	11.700	52.000	6.50	6.35	8.25
31	11.775	11.700	52.000	6.50	6.35	8.25
			AVERAGES FOR MONTH			
Jan.	11.775	11.508	52.000	6.275	6.125	8.250
Jan.			AVERAGES FOR WEEK			
7	11.775	11.200	52.000	5.850	5.700	8.250
14	11.775	11.283	52.000	6.067	5.917	8.250
21	11.775	11.700	52.000	6.500	6.350	8.250
28	11.775	11.700	52.000	6.500	6.350	8.250
Jan.			CALENDAR WEEK AVERAGES			
3	11.775	11.200	52.000	5.850	5.700	8.250
10	11.775	11.200	52.000	5.850	5.700	8.250
17	11.775	11.533	52.000	6.392	6.242	8.250
24	11.775	11.700	52.000	6.500	6.350	8.250
31	11.775	11.700	52.000	6.500	6.350	8.250

SILVER, GOLD AND STERLING EXCHANGE

1942 Jan.	Sterling Exchange: "Checks" (Nominal)	Sterling Exchange: "90-day demand"	Silver (c): New York	Silver (c): London	Gold: London	Gold (d): United States
2	401.000	(f)	35.125	23.500	168s	$35.00
3	401.000	(f)	(e)	(e)	(e)	35.00
5	401.000	(f)	35.125	23.500	168s	35.00
6	401.000	(f)	35.125	23.500	168s	35.00
7	401.000	(f)	35.125	23.500	168s	35.00
8	401.000	(f)	35.125	23.500	168s	35.00
9	401.000	(f)	35.125	23.500	168s	35.00
10	401.000	(f)	(e)	(e)	(e)	35.00
12	401.000	(f)	35.125	23.500	168s	35.00
13	401.000	(f)	35.125	23.500	168s	35.00
14	401.000	(f)	35.125	23.500	168s	35.00
15	401.000	(f)	35.125	23.500	168s	35.00
16	401.000	(f)	35.125	23.500	168s	35.00
17	401.000	(f)	(e)	(e)	(e)	35.00
19	401.000	(f)	35.125	23.500	168s	35.00
20	401.000	(f)	35.125	23.500	168s	35.00
21	401.000	(f)	35.125	23.500	168s	35.00
22	401.000	(f)	35.125	23.500	168s	35.00
23	401.000	(f)	35.125	23.500	168s	35.00
24	401.000	(f)	(e)	(e)	(e)	35.00
26	401.000	(f)	35.125	23.500	168s	35.00
27	401.000	(f)	35.125	23.500	168s	35.00
28	401.000	(f)	35.125	23.500	168s	35.00
29	401.000	(f)	35.125	23.500	168s	35.00
30	401.000	(f)	35.125	23.500	168s	35.00
31	401.000	(f)	(e)	(e)	(e)	35.00
			AVERAGES FOR MONTH			
Jan.	401.000	.....	35.125	23.500	....	35.00
Jan.			AVERAGES FOR WEEK			
7	401.000	.....	35.125	.....	....	.....
14	401.000	.....	35.125	.....	....	.....
21	401.000	.....	35.125	.....	....	.....
28	401.000	.....	35.125	.....	....	.....

Calendar week averages, New York Silver: Jan. 3rd, 35.125; 10th, 35.125; 17th, 35.125; 24th, 35.125; 31st, 35.125.
(e) Not quoted. (f) No quotations.

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Owing to the World War and the disruption of normal trade relations, our export copper quotations, since September, 1939, have been based largely on f.a.s. transactions, ex United States ports. To arrive at the f.o.b. refinery quotations deduct .05c. from the f.a.s. basis for lighterage.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c per pound over the current market for Prime Western but not less than 1c over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly-mined domestic, by Handy & Harman. Under Treasury order of July 6, 1939, the price on domestic newly-mined silver mined subsequent to July 1, 1939, was fixed at 71.11c per troy ounce. Handy & Harman's quotation on newly-mined domestic silver, 999 fine was 70⅝c. throughout January.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125.

cover the entire first quarter of 1942. With war needs for zinc increasing, a strong possibility exists that full priority control will be imposed after March 31.

Smelting capacity for tin at the plant now under construction at Texas City, Tex., is to be increased to 50,000 tons of metal a year, owing to the situation in the Pacific. Original plans called for 18,000 tons a year.

Quicksilver production in the United States totaled more than 43,000 flasks of 76 lb. each during 1941, yet little metal was offered to consumers during January and the price advanced to $202.50 per flask, New York.

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LONDON TIN—Trading in Standard tin in London remained suspended throughout January.

OFFICIAL LONDON PRICES—COPPER, LEAD, ZINC

Following are the maximum prices of copper, lead, and zinc established by the Ministry of Supply for the British market, in effect since Dec. 18, 1939:

	Per £	Long Ton s.	d.
COPPER:			
Electrolytic, high conductivity	62	0	0
Fire refined, high conductivity	62	0	0
Fire refined, high grade	61	10	0
Fire refined, min. 99.7 percent	61	0	0
Fire refined, min. 99.2 percent	60	10	0
Hot rolled black wire rods	65	10	0
LEAD:			
Soft foreign, duty paid	25	0	0
Soft, Empire	25	0	0
English refined	26	10	0
ZINC:			
Foreign (G.o.b.), duty paid	25	15	0
Domestic (G.o.b.)	26	10	0
Prime Western and debased	26	10	0
Refined and electrolytic	27	5	0
Minimum 99.99 percent	28	15	0

Quotations are for metal delivered to the consumer.

E & M J PRICE INDEX

Weighted index of non-ferrous metal prices. The average for the years 1922-1923-1924 equals 100.

1929	110.33	1935	74.66
1930	82.87	1936	73.45
1931	60.20	1937	90.86
1932	48.26	1938	73.67
1933	59.79	1939	77.71
1934	69.59	1940	79.22
		1941	83.49

	1940	1941	1942
January	80.85	82.48	85.39
February	77.23	82.76	....
March	77.94	83.27	....
April	77.19	83.48	....
May	77.68	83.51	....
June	78.85	83.48	....
July	76.72	83.60	....
August	76.71	83.39	....
September	79.40	83.34	....
October	82.49	83.84	....
November	83.14	84.32	....
December	82.42	84.42	....

CURRENT PRICES — MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(Feb. 2, 1942)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb	15c
Antimony, domestic, spot, lb	14.00c
Bismuth, ton lots, lb	$1.25
Cadmium, commercial sticks, lb	90c.
Calcium, lb., ton lots 97 @ 98 per cent	$1.25
Chromium, 97 per cent grade, lb	89c.
Cobalt, 97 to 99 per cent, per lb	$1.50
Nickel, electrolytic cathodes, lb	35c.
Magnesium, 99.8 per cent, carloads, lb	27c.
Palladium, troy oz	$24.00
Platinum, (Official quotation) troy oz	$36.00
Quicksilver, flask of 76 lb., 100 flasks or more	$202.50
Radium, mg. radium content	$25.00@$30.00
Selenium, 99.5 per cent, lb	$1.75
Silicon, minimum 97 per cent, spot, lb	16.50c.
Tellurium, lb	$1.75
Thallium, 100 lb. or more, lb	$10.00
Titanium, 96 to 98 per cent, lb	$5.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 48 @ 50% Cr_2O_3 c.i.f. Atl. ports, long ton	(b)$40.00@$41.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$4.75
Mesabi bessemer	$4.60
Old Range non-bessemer	$4.60
Mesabi, non-bessemer	$4.45
Lead (Galena) 80 per cent, Joplin, Mo., ton	$76.75
Manganese Ore, (foreign) c.i.f. U.S. ports, long ton unit of Mn:	
52 @ 55 per cent	(b) 70c.
50 @ 52 per cent	(b) 68c.
46 @ 48 per cent	(b) 66½c.
Molybdenum Ore, 90%, per lb. of MoS_2, f.o.b. mines	45c.
Tungsten Ore, per unit of WO_3:	
Chinese, 65 per cent, duty paid	(b) $24.00
Domestic, 65 per cent and upward	(a)$26.00
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton	$55.28

(a) Prices at mines, small lots, usually several dollars less. (b) Nominal.

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb	4c
Cobalt Oxide, 70 @ 71 per cent, lb	$1.84
Copper Sulphate, 100 lb	$5.15
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb	$1.43
Sodium Sulphate, bulk, ton	$18.00@$24.00

ALLOYS

Beryllium Copper, master alloy, 2.5 to 3 per cent Be, per lb. of contained Be	$15.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, per pound of Cr contained	13c.
Ferromanganese, 78 @ 82 per cent, gross ton	$120.00
Ferromolybdenum 55 @ 65 per cent Mo. lb. of Mo. contained	95c.
Ferrosilicon, 50 percent, gross ton	$74.50
Ferrrotungsten, 75 @ 80 per cent, lb. of W contained	$1.90
Ferrovanadium, per lb. of V, delivered	$2.70@$2.90

NON-METALLIC MINERALS

Asbestos, f.o.b. Canadian (Quebec) mines (U.S. funds), ton;	
Crude No. 1	$700@$750
Crude No. 2	$150@$350
Spinning fibers	$110@$200
Paper stock	$40@$49.50
Shorts	$13@$17.50
Vermont, f.o.b. Hyde Park:	
Shingle stock	$57.00@$60.00
Paper stock	$40.00@$48.00
Shorts	$13.00@$26.00
Floats	$18.00
Barytes, long ton:	
Georgia, crude	$8.00
Missouri, 93 per cent $BaSO_4$, less than 1 per cent iron	$6.00@$6.50
Bauxite, long ton:	
Domestic, crude, 50 @ 52 percent (not dried)	$5.00
Domestic, chemical, 55 @ 58 per cent	$7.50@$8.50
Domestic, abrasive, 80 @ 84 per cent	$16.00
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, No. 1, bulk	$6.75@$8.00
Delaware, No. 1	$14.50
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton	$25.00
Ground, 95 @ 98 percent, bulk, ton	$34.00
Lump, acid, 98 percent, bulk, ton	$32.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00
Dead-burned, f.o.b. Washington	$22.00
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½ x 2 in.	45@65c.
2 x 2 in.	60@85c.
3 x 3 in.	$1.85@$2.05
3 x 4 in.	$2.15@$2.25
3 x 5 in.	$2.50@$2.75
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12c
Silica, in bags, 325 mesh, ton	$20.00@$40.00
Sulphur, Texas, mines, long ton	$16.00
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.50@$10.50
Vermont, extra white, 200 mesh	$9.50@$10.00
Tripoli, Missouri, ton:	
40 mesh, cream colored	$14.50
200 mesh, cream colored	$26.00

(a) Nominal

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$24.50
Basic	$23.50
No. 2 Foundry	$24.00
Steel, base prices, Pittsburgh:	
Billets, gross ton	$34.00
Structural shapes, 100 lb	$2.10
Bars, 100 lb	$2.15

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1941	1942	1941	1942	1941	1942
January	34.750	35.125	23.273	23.500	(a) 402.000	(a) 401.000
February	34.750	.....	23.341	.....	(a) 401.864	.....
March	34.750	.....	23.446	.....	(a) 401.788	.....
April	34.750	.....	23.500	.....	(a) 401.058	.....
May	34.750	.....	23.457	.....	(a) 400.981	.....
June	34.750	.....	23.400	.....	(a) 401.000	.....
July	34.750	.....	23.397	.....	(a) 401.000	.....
August	34.750	.....	23.459	.....	(a) 401.000	.....
September	34.750	.....	23.500	.....	(a) 401.000	.....
October	34.750	.....	23.500	.....	(a) 401.000	.....
November	34.772	.....	23.500	.....	(a) 401.000	.....
December	35.125	.....	23.500	.....	(a) 401.000	.....
Year	34.783	.....	23.439	.....	(a) 401.224	.....

New York quotations for silver other than newly-mined domestic, cents per ounce troy, 999 fine. London pence per ounce sterling silver 925 fine. Sterling exchange (pound sterling) in cents. (a) Nominal.

COPPER

	F.O.B. Refinery, Electrolytic			
	Domestic		Export	
	1941	1942	1941	1942
January	11.819	11.775	10.257	11.508
February	11.794	.....	10.414	.....
March	11.814	.....	10.592	.....
April	11.820	.....	10.952	.....
May	11.815	.....	10.950	.....
June	11.810	.....	10.950	.....
July	11.812	.....	10.950	.....
August	11.778	.....	10.950	.....
September	11.775	.....	11.027	.....
October	11.775	.....	11.367	.....
November	11.775	.....	11.200	.....
December	11.775	.....	11.200	.....
Year	11.797	.....	10.901	.....

New York quotations, cents per pound.

LEAD

	New York		St. Louis	
	1941	1942	1941	1942
January	5.500	6.275	5.350	6.125
February	5.602	.....	5.452	.....
March	5.765	.....	5.613	.....
April	5.850	.....	5.700	.....
May	5.850	.....	5.700	.....
June	5.850	.....	5.700	.....
July	5.850	.....	5.700	.....
August	5.850	.....	5.700	.....
September	5.850	.....	5.700	.....
October	5.850	.....	5.700	.....
November	5.850	.....	5.700	.....
December	5.850	.....	5.700	.....
Year	5.793	.....	5.643	.....

New York and St. Louis quotations, cents per pound.

TIN

	Straits New York		Standard, Spot London	
	1941	1942	1941	1942
January	50.154	52.000	256.648	(b)
February	51.293	.....	264.975	.....
March	52.067	.....	270.131	.....
April	51.981	.....	269.775	.....
May	52.166	.....	267.534	.....
June	52.685	.....	262.750	.....
July	53.481	.....	258.272	.....
August	52.385	.....	257 013	.....
September	52.000	.....	256.364	.....
October	52.000	.....	255.842	.....
November	52.000	.....	256.713	.....
December	52.000	.....	(a) 257.625	.....
Year	52.018	.....	261.137	.....

New York quotations, cents per pound. London, pounds sterling per long ton. Average of 6 days. Quotations suspended Dec. 9. (b) Not quoted.

ZINC

	St. Louis			
	1939	1940	1941	1942
January	4.500	5.644	7.250	8.250
February	4.500	5.534	7.250	.....
March	4.500	5.750	7.250	.....
April	4.500	5.750	7.250	.....
May	4.500	5.803	7.250	.....
June	4.500	6.235	7.250	.....
July	4.516	6.250	7.250	.....
August	4.719	6.389	7.250	.....
September	6.104	6.920	7.250	.....
October	6.500	7.250	7.942	.....
November	6.500	7.250	8.250	.....
December	5.980	7.250	8.250	.....
Year	5.110	6.335	7.474	.....

St. Louis quotations, Prime Western, cents per pound.

CADMIUM AND ALUMINUM

	Cadmium		Aluminum	
	1941 (a)	1942 (a)	1941	1942
January	80.000	90.000	17.000	15.000
February	82.273	.....	17.000	.....
March	89.038	.....	17.000	.....
April	90.000	.....	17.000	.....
May	90.000	.....	17.000	.....
June	90.000	.....	17.000	.....
July	90.000	.....	17.000	.....
August	90.000	.....	17.000	.....
September	90.000	.....	17.000	.....
October	90.000	.....	15.000	.....
November	90.000	.....	15.000	.....
December	90.000	.....	15.000	.....
Year	88.443	.....	16.500	.....

Aluminum in cents per pound, 99 plus per cent grade. Cadmium, cents per pound. (a) Producers' price, commercial sticks.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1941	1942	1941	1942	1941	1942
January	14.000	14.000	165.846	202.519	36.000	36.000
February	14.000	.....	170.182	.....	36.000	.....
March	14.000	.....	177.692	.....	36.000	.....
April	14.000	.....	180.077	.....	36.000	.....
May	14.000	.....	180.000	.....	36.000	.....
June	14.000	.....	183.920	.....	36.000	.....
July	14.000	.....	188.577	.....	36.000	.....
August	14.000	.....	192.000	.....	36.000	.....
September	14.000	.....	192.440	.....	36.000	.....
October	14.000	.....	193.615	.....	36.000	.....
November	14.000	.....	196.273	.....	36.000	.....
December	14.000	.....	199.654	.....	36.000	.....
Year	14.000	.....	185.023	.....	36.000	.....

(a) Antimony, cents per pound, ordinary brands, in cases; in bulk f.o.b. Laredo, Tex., 13.000 for January. (b) Quicksilver, dollars per flask of 76 lb. (c) Platinum, per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1941	1942	1941	1942	1941	1942
January	24.50	24.50	23.50	23.50	24.00	24.00
February	24.50	.....	23.50	.....	24.00	.....
March	24.50	.....	23.50	.....	24.00	.....
April	24.50	.....	23.50	.....	24.00	.....
May	24.50	.....	23.50	.....	24.00	.....
June	24.50	.....	23.50	.....	24.00	.....
July	24.50	.....	23.50	.....	24.00	.....
August	24.50	.....	23.50	.....	24.00	.....
September	24.50	.....	23.50	.....	24.00	.....
October	24.50	.....	23.50	.....	24.00	.....
November	24.50	.....	23.50	.....	24.00	.....
December	24.50	.....	23.50	.....	24.00	.....
Year	24.50	.....	23.50	.....	24.00	.....

Iron, dollars per long ton. F.o.b. Mahoning and Chenango Valley furnaces.

PERSONAL ITEMS

A. E. Jukes, president of Gold Belt Mining Co., Ltd., was elected president of the B. C. Chamber of Mines for 1942.

N. E. McConnell, superintendent of Privateer Mine, Ltd., has been re-elected president of the Zeballos Board of Trade.

David D. Baker, 145 Sansome St., San Francisco, is in charge of mining for the United States Vanadium Corp.

Edward S. Kneeland, metallurgical plant designer, recently left New York City for Los Angeles, Calif.

A. P. Cortelyou is at Selukwe, Southern Rhodesia, in connection with the British chromium industry.

Roger W. Straus, president of the American Smelting & Refining Co., New York, recently visited Salt Lake City, inspecting operations.

Robert W. Wilson has joined the staff of the engineering office of Certainteed Products Corp. and has established his residence at Kenmore, N. Y.

Russell W. Mumford has assumed the post of manager of American Potash & Chemical Corp. at Trona, Calif. He succeeds A. D. Hoffman.

Peter P. Ribotto has been promoted to the position of chief engineer for the northern Michigan mines of the Inland Steel Co.

Ralph Hayden has joined the staff of International Smelting & Refining Co. as mill superintendent of that company's Copper Canyon property at Battle Mountain, Nevada.

Byron G. Best has been appointed supervisor of safety in the Industrial Relations Department of the Oliver Iron Mining Co. with headquarters in Duluth, Minn.

D. C. Sharpstone, general manager of Canbrae Exploration Co., Ltd., Bralorne subsidiary, has returned to Vancouver after spending the past season engaged in professional work in eastern Canada.

James G. Traill has left Canada to take an appointment with the Demerara Bauxite Co., a subsidiary of the Aluminum Company of Canada, at Mackenzie, British Guiana.

E. P. Frink has resigned as resident manager of Soc. Minera Pirquitas, Buenos Aires, Argentina, and is now assistant general manager of Sominar Sociedad Minera, Argentina, S. A.

C. E. Millikan, formerly chief engineer of the San Luis Mining Co., Tayoltita, Dgo., Mexico, has joined the staff of the Cia. Minera de Peñoles, S. A., as chief engineer of the Avalos, Zacatecas unit.

P. B. Freeland, of the British Columbia Department of Mines, was elected president of the Association of Professional Engineers at its annual meeting.

Bert M. Brock has been appointed manager of industrial relations for the John A. Roebling's Sons Co., whose plants in Trenton and Roebling, N. J., are producing materials and supplies for the Army and Navy.

Horace J. Allen, of Cleveland, Ohio, has been appointed vice president in charge of sales of the Evergreen Mines Co., Crosby, Minn. Since 1932 he has been ore agent for the Evergreen Mines Co. with offices in Cleveland, where he will continue to make his headquarters.

Waldemar I. Konkoff, consulting mining geologist for Hixbar Gold and Antipolo Mining companies, Philippine Islands, has been appointed general superintendent of the latter company. He has been associated with both organizations since 1939.

Dr. Bradley Stoughton, president, and **W. H. Eisenman,** secretary, of the American Society for Metals, addressed the British Columbia chapter of the society on Jan. 12. Dr. Stoughton also addressed the Vancouver branch of the C.I.M.M.

N. P. Goodrich, of the Bald Mountain Mining Co., of Trojan, S. D., was elected chairman of the Black Hills section of the American Institute of Mining and Metallurgical Engineers at the annual banquet and meeting in Deadwood Jan. 23.

Robert M. Keeney, since 1939 industrial manager of the Connecticut Light & Power Co., Waterbury, and widely known in the mining and metallurgical fields, has been appointed assistant chief of the nickel branch of the materials division, War Production Board, Washington, D. C.

Charles F. Williams, for 18 years Mining Supervisor for the U. S. Geological Survey at Miami, Oklahoma, has left the Tri-State District for foreign military duty. **James McKim,** formerly Mining Engineer in the Salt Lake City Office of the Survey, succeeds Colonel Williams in charge of the Miami district.

Henry A. Saller has been named a research engineer on the technical staff of Battelle Memorial Institute, Columbus, Ohio, and has been assigned to research in metallurgy. A graduate in metallurgy of Purdue University, Mr. Saller was associated with the Carnegie-Illinois Steel Corporation prior to joining the Battelle staff.

Robert W. Willoughby recently returned from the Philippines, where he was mill superintendent for Baguio Gold Mining Co., and is now acting as mill superintendent at the Duquesne unit of the Callahan Lead-Zinc Co. near Washington Camp, Ariz.

Horace R. Graham, executive vice president of Anglo-Chilean Nitrate Corp., and **Sali Hochschild,** operator of several Chilean mines, both graduates of Columbia School of Mines, represented the University at the First Pan-American Congress of Mining Engineering and Geology held in Santiago, Chile, from Jan. 11 to 20.

Charles A. Reichelderfer has joined the research staff of Battelle Memorial Institute, Columbus, Ohio, where he has been assigned to the division of nonferrous metallurgy. Mr. Reichelderfer is a graduate of Purdue University. Prior to joining the Battelle staff he was associated with the Jones and Laughlin Steel Corporation, Pittsburgh.

B. A. Gould, of H. W. Gould & Co., mining and metallurgical engineers, San Francisco, has just returned from a trip to Peru to investigate the Huancavelica mercury mine. This is the famous old mercury producer which has a greater production record than that of any other mercury mine in the Western Hemisphere. It is possible that, conditions allowing and if materials are available, a new large reduction plant will be installed on this property in the near future.

Alva H. Gunnell, mining engineer of Albuquerque, N. M., having recently completed a survey and report on the fluorspar industry and resources of southwestern New Mexico for New York interests, has departed on an extended field trip down the West Coast of Old Mexico. Mineral deposits to be examined in the States of Sinaloa and Durango include tin, quicksilver, gold-silver, and gold placer. His temporary headquarters will be Hotel Belmar, Mazatlan, Sinaloa, Mexico. Mr. Gunnell expects to return to Albuquerque the last week of January.

Pickands, Mather & Co., of Cleveland, Ohio, have added four new member partners to the firm. **A. D. Chisholm,** of Duluth, general manager for the company's iron mines, was one of the four admitted as partners. The other three new partners are **Herbert C. Jackson,** of Cleveland, Ohio, secretary for most of the companies managed by Pickands, Mather & Co.; **John Sherwin** of Cleveland, Ohio, resigned as the vice president for the Cleveland Trust Co. to become a partner, and **George Striebing,** of Cleveland, who has been in the traffic and pig iron and coke sales division of the company in Cleveland.

H. S. Sherman, general superintendent for the Oliver Iron Mining Co. in the Hibbing-Chisholm district, has made the following appointments, effective Jan. 1st, 1942: **J. H. Herding, Jr.,** superintendent Hibbing-Chisholm district. **W. N. Matheson, Jr.,** superintendent God-

frey-Morris underground mine, in Hibbing, and Leonard Burt Mine in Chisholm. **G. B. Pyles,** superintendent of maintenance Hibbing-Chisholm district. **E. G. Stone,** superintendent of the crusher plant and construction in Hibbing. **John Chisholm,** assistant superintendent Hull-Rust mine, Hibbing. **H. A. Pickering,** assistant superintendent Morris mine, Hibbing. **S. R. Micka,** supervisor of production Hull-Rust mine, Hibbing. **S. F. Flynn,** general pit foreman Hull-Rust mine, Hibbing. **J. E. Machamer,** assistant superintendent Hartley-Fraser Mines, Chisholm.

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OBITUARY

Paul F. Boswell, geologist and consulting mining engineer, died recently in the Philippines.

Sikko Barghoorn, president of Kaaba-Texas Mining Co., died at San Francisco, on Dec. 11, 1941. His age was 66 years.

William Tanner, long prominent in mining circles of the Pacific Northwest, died on Dec. 28 in Seattle, Wash. He was 78 years old.

James W. Gwinn, long associated with Bunker Hill & Sullivan Mining & Concentrating Co., and since 1933 secretary of the Idaho Mining Association, died on Dec. 8 last. He was 53.

James F. Spiers, superintendent of the Central Eureka Mine, at Sutter Creek, Calif., died Dec. 22, 1941. He was one of the best known superintendents of the California Mother Lode district.

O. F. Riser, 59, founder and president of the National Equipment Co., Salt Lake City, died on Dec. 19. Born in Salt Lake City, June 12, 1882, he was graduated from the University of Utah. Mr. Riser started in the mining business at Mercur, Utah, and later worked for the Utah Copper Company. He had been general mill foreman at the Chino Mines in New Mexico and later mill superintendent.

Halleck W. Seaman, 81, long a leader in the development of civic and industrial betterment of the Middle West, who spent many years of his life in mining and railroad projects in that section of the country, died in Clinton, Iowa, on Dec. 15. He had been prominent in gold mining activities in South Dakota and in 1923 was president of the American Mining Congress. He was formerly president of the Trojan Mining Company.

George A. Kervin, mining engineer, died Jan. 1 as a result of an accidental fall down a raise in the Gray Eagle Mining Company's property, Happy Camp, Calif. He was born in Virginia City, Nev., 63 years ago. His professional work took him to all parts of the world, one of his recent jobs being the design, construction, and operation of the plant of the O'Okiep Copper Co., Ltd., Namaqualand, South Africa. At the time of his death he was reopening the Gray Eagle property.

Fernand Pisart, Belgian mining engineer, widely known in business and financial circles in this country, died on Jan. 20, 1942, at New York. He was 64 years old. Mr. Pisart was Commander of the Order of Leopold, Officer of the Order of the Crown, Officer of Orange-Nassau, and Officer of the Legion d'Honneur. He was the head of the Maastrichtsche Zinkwit company and many other important concerns. Mr. Pisart was sent to this country in 1940, at the request of the Belgian Government, as chief economic advisor for the duration of the war. Prior to his becoming a Belgian Government official, Mr. Pisart was President of the African Metals, Corp., 25 Broadway, New York.

FERNAND PISART

John H. Stoddard, 87, Nevada mining pioneer, who had been associated with many mining companies on the Comstock Lode and who was one of the first to supervise the use of diamond drills in mining, died on Jan. 21 at Virginia City, Nev.

Walter E. Trent, mining engineer and president of the Rocky Mountain Metals Foundation, died in Washington, D. C., Jan. 18. He was born at Boulder, Colo., and educated in Utah and California. He left Stanford University, where he was a student, for Tasmania and Australia with his father to examine copper properties. During the first World War, Trent trained at Plattsburgh as a reserve officer, receiving the rank of Major. He was a member of the A.I.M.E.

John F. Telfer died Dec. 1 after a short illness, in Burlingame, Calif. As a young man he followed mining, and in the employ of Bewick-Moreing & Co. was sent to distant outposts. He spent a period of years in charge of gold properties on the Gold Coast of West Africa and in Western Australia. Coming to the United States about 30 years ago, Telfer was employed as an engineer with Arizona copper properties, including the Copper Queen at Bisbee. He subsequently worked for Chas. H. Segerstrom in San Francisco and at Sonora, Calif.; and for other interests at various California properties including the Atolia, Beebe, and Pine Tree mines.

Raymond Denver Butterfield, superintendent of Reed Mine, Yolo County, Calif., died on Dec. 4, 1941, in the mine office. Butterfield was born in Denver on March 28, 1892, and started working underground at the age of 16. He made his first stake at the Vindicator Mine when 19 years old. Through the years he leased and operated in the Ward, San Juan, Gunnison, and Cripple Creek districts. He worked for three years on the driving of the Hetch Hetchy tunnel. In 1933 he became superintendent of the San Juan Mine, a gold property operated by the Bradley Mining Co. in Nevada County, Calif.

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A LETTER

Converter Smelting

The Editor:

THE LETTER of Milo W. Krejci in December *Engineering and Mining Journal* is interesting and informative. I would like to make a few remarks as to the critical aspect of certain matter therein, which arises, I believe, chiefly from a difference in viewpoint. The compelling effort to find some means of reducing the values of sulphide ores to transportable bulk without the use of carbonaceous fuel did not come from any desire to compete with the methods used in large plants but for the purpose of exploiting mining properties inaccessible under the ordinary procedure of mining and shipping ore to the custom smelter. Even where milling is practiced, a truly pyrite smelter could be made to consume an enormous amount of siliceous ore, as flux, without milling, as well as obviating the necessity of discarding the pyrite. Such isolated plants could serve as proving ground for ideas which could be applied at larger plants.

It is true that the power for the blowing engine is the major item, yet hydro-electric power, siliceous ores, and sulphides may frequently be found together and the cost of power need not exceed 60c. per ton of ore smelted. Handling costs should be normal with the use of bunkers, belts, and a charging contrivance on the order of the Gargun.

The converter has been essentially a refining furnace for the molten matte from an ore-smelting furnace. This refining has required the use of siliceous ores as flux. Converter plant cleanings, refinery slags, and the like are also disposed of in the converter to a limited extent. Concentrates have been used in proportions up to 50 percent of the weight of the molten matte charged. However, since a limited plant, with high concentration of product and without the necessity of transporting coal into the mountains, was my objective, I made the proposal of total smelting in a converter.

John Hollway stated: "If a rapid current of air is forced through molten sulphides the maximum temperature of the combustion is obtained." I believe this to be axiomatic and Rule 1 in any attempt to achieve ideal pyritic smelting, and it naturally suggests the converter type apparatus.

F. E. WING

Tacoma, Wash.

News OF THE INDUSTRY

Higher Metal Prices for Miners Based on Quotas

All over-quota production will be acquired by Metals Reserves at 17¢ for copper, 11¢ for zinc and 9¼¢ for lead

THE mining and mineral industries must produce at maximum speed. There is nothing new in that objective. But several new stimulants for mining activity have been offered during January. Most significant was the plan presented by Federal Loan Agency Administrator Jesse H. Jones in his announcement of Jan. 12, addressed to Knudsen and Henderson, then executives of OPM. The text of his letter tells the story simply and effectively, as follows:

"You are advised that, in accordance with your suggestion, Metals Reserve Company will, at your request, for a period of two and one-half years from Feb. 1, 1942, pay 11c. per pound East St. Louis for zinc, 9¼c. per pound New York for lead, and 17c. per pound Connecticut Valley for copper, for increases above 1941 production governed by quotas to be fixed by you with our approval.

"This price will apply also to mines which were not operated at all in 1941, and to new mines, but will not apply to production already arranged for by specific agreement. Consideration will be given to a longer purchase agreement than two and one half years where the expansion of facilities is necessary.

"Any metals so acquired by Metals Reserve Company which are not used for or by the government will be subject to your allocation at the ceiling price fixed by the Price Administrator. By this procedure we should get maximum production of these critical and strategic metals for war purposes without increasing the price to the consumer."

The plan developed under this authority will, officials estimate, "increase lead and zinc production by at least 30 percent over the current rate by the end of 1942 and substantially increase copper production."

Much difficulty is being experienced in determining just how increased production, entitled to increased prices, will be calculated. Washington recognizes that certain new output may be low-cost and, therefore, not deserving of special price stimulus. On the other hand, there are numerous firms that have gone ahead with high-cost production without profit, or even at a loss, and these should be compensated as a matter of justice. It appears, therefore, that individual companies will have to be assigned definite quotas on the basis of which bonus above the normal price ceiling will be paid.

All of the over-quota output acquired by Metals Reserve Company will go into Government production directly or through allocation to contractors. The charge for this metal, where any money transaction is involved, will be the prevailing price ceilings which are 12c. Valley for copper, 6½c. New York for lead, and 8¼c. St. Louis for Prime Western zinc. Thus, Metals Reserve Company will absorb certain losses incurred.

Early this month Federal Loan Administrator Jesse Jones announced that the higher prices would apply to February production above the quotas to be set by the War Production Board. Before the higher prices would be paid, each producer will have to furnish a sworn affidavit, following the end of each month, showing his total production, his monthly quota, and the amount of his excess output.

Colorado Miners Convene

Forty-fifth annual meeting of Colorado Mining Association devoted to problems growing out of the war

COLORADO MINING MEN gathered in Denver Jan. 23 and 24 for a two-day clinic on the effect of the war on their operations. They listened to speakers on selective service, vocational training, workmen's compensation, social security, recruiting, and other matters vital to their business. Pledged to make its utmost contribution to the winning of the war, the Association conferred also with representatives of the Government on ways and means of cooperation for the greatest possible production of war metals and minerals.

Major A. R. Jones, state adviser on occupational deferments, made it clear that, although nothing must be allowed to interfere with production of raw materials, employers must nevertheless be prepared to lose common labor. Skilled labor essential to the mining of war metals will be deferred as long as possible, and local boards should take a firm attitude in this matter. Because there is little or no opportunity for the employment of women in mining, employers must train and up-grade men now in their employ if ore production is to be increased to meet war needs. The extent to which selective service may draw on Colorado was discussed by John R. Gross, regional director. He pointed out that Colorado's population is about 1 percent of that of the whole country, and that for an army of seven million men the State's quota would be about 70,000.

The outlook for gold mining was discussed by Merrill E. Shoup, president, Golden Cycle Corporation. The immediate outlook is not particularly bright, because new developments cannot be encouraged unless gold production also yields substantial quantities of the base metals.

G. C. Bateman, Metals Controller for Canada, was the principal speaker at the banquet. He reviewed Canada's war effort and explained the functions of his office. At the famous Sowbelly dinner, Dr. Wilbur A. Nelson, administrator of priorities for the mining industry, heartened his audience by declaring that mining and the production of munitions were equally important in the war effort and should be placed on a parity in the matter of priorities. Dr. Nelson's branch of the new War Production Board is functioning with energy and efficiency and is prepared to assist the mining industry and equipment manufacturers in obtaining machinery and raw materials wherever they are necessary to the production of war metals. He explained the relative unimportance of gold mining at this time, and his unwillingness to see equipment diverted to new projects in that direction. But he also made it clear that gold mines that turned out a substantial tonnage of base metals are entitled to every consideration in priorities. After the convention was over Dr. Nelson held a special meeting for equipment manufacturers and sought their aid and support to enable him to fight their battles in Washington.

The convention was marked by unusual enthusiasm, patriotic devotion, and determination to win the war. An excellent mining show was held, consisting of a parade of floats, exhibits of machinery manufacturers, safety team contests, mucking contests, and an exhibition of hand rock drilling.

Officers elected for the ensuing year were: Chairman and president emeritus, Jesse F. McDonald; president, Edward L. Thornton; vice presidents, C. T. Van Winkle, Walter E. Scott, Jr., LeRoy Burkett and J. E. Byron; secretary, Robert S. Palmer; treasurer, Charles N. Bell.

One of the many interesting visits made by members of the Pan-American Mining Congress was the trip to the world's largest copper deposit of the Chile Exploration Co. at Chuquicamata, operated by modern open-pit methods

Success Marks First Pan-American Mining Congress Held in Chile

John B. Huttl
Assistant Editor

MORE than 320 mining engineers, geologists, mine owners, and operators, including official delegates from 16 American countries, met in Santiago, Chile, on Jan. 15, 1942, to attend the First Pan-American Congress of Mining Engineering and Geology, to discuss there the different problems, both economic and technical, confronting the mining industry of the Western Hemisphere, and to bring about closer friendship and a permanent interchange of opinions and ideas of mining engineers and geologists of the Americas.

The idea was conceived in 1940 by the board of the Institute of Mining Engineers of Chile, and was carried to completion in 1942 with the official sanction of the Government of Chile. The executive committee, composed of Ing. Marin Rodriguez, president; Ing. Roberto Muller, executive vice president; Ings. Osvaldo Vergara and Enrique Vial, and Sr. Tomás Vila, directors; and Ing. Américo Albala, secretary, can justly be proud of the results achieved. An atmosphere of good will, cooperation, and cordiality prevailed at all sessions and the social functions, hospitality, and courtesies shown to the visiting engineers by their Chilean confrères will long be remembered. Many interesting papers covering subjects such as mining, milling, smelting, geology, fuels, sulphur, nitrate, mining policy, legislation, economy, and mining education read during the various sessions held at the Escuela de Ingenieria. Ensuing discussions were interesting and at times lively.

The preliminary morning session was given over to election of officers of the Congress. Ing. Marin Rodriguez, who presided, was elected president. The following were elected vice presidents: Tomás Ezcurra, Argentina; Roberto Arce, Bolivia; Juarez Tavora, Brazil; Hon. W. F. A. Turgeon, Canada; Charles Will Wright, United States; Roberto Müller, Chile; Santiago Londoña, Colombia; Alvaro Bonilla, Costa Rica; R. C. Palominos, Cuba; Enrique C. Silva, Equador; Luis Molina W. Honduras; Germán Garcia, Mexico; Fernando Saguier, Paraguay; Alberto Jochanowitz, Peru; Maximo Lovatón, Santo Domingo; and Carlos R. Vegh Garzon, Uruguay, with Américo Albala as secretary general of the Congress. During this session homage was also paid to the late President of Chile, Aguirre Cerda.

The Congress was formally opened during the afternoon session presided over by the vice president of the Republic of Chile, His Excellency Jerónimo Mendez. The principal speech of welcome was made by Sr. Merino Reyes, Ministro de Fomento of Chile, which was followed by those of Ing. Marin Rodriguez, president of the Congress; Dr. Gustavo Lira, dean of the Faculty of Sciences and Mathematics, University of Chile; Charles Will Wright, chief delegate of the United States; Sr. Ramón C. Palominos, delegate of Cuba; Ing. Tomás Ezcurra, delegate of Argentina; and Juarez Tavora, delegate of Brazil. All stressed the importance of continental solidarity, cooperation in solving economic and technical matters relating to mining and other industrias, and the rôle metals and minerals are playing in the present world conflict. A banquet given in the evening by the Institute of Mining Engineers of Chile at the famous Cerro San Cristobal closed the proceedings of the day. All sessions were held in the main assembly hall of the University of Chile.

South American Deposits

The technical sessions commenced Friday morning, Jan. 16, at the Escuela de Ingenieria. After establishment of the various commissions with presiding officers covering mining, milling, smelting, geology, fuels, and others, papers on these divers subjects were read at respective lecture rooms. The principal topics discussed by the commission handling political matters relating to mining were (1) establishment of a permanent Pan-American Institute of Mining and Geology, and (2) the mineral resources of South America, especially the difficulties encountered under present conditions as to their exploitation, distribution, and sale. In the room occupied by the mining commission a host of papers were read under the chairmanship of Ing. Guillermo Bilbao La Vieja. These included "El Rico Tesoro de las Minas en Honduras," by Luis Molina Wood; "Estado Actual de la Mineria en Nicaragua," by Oscar Sevilla; "Desarrollo y Posibilidades de la Mineria Peruana," by David Torres; "El Cobalto en Chile," by H. Hornkoh; "Sugerencia para Standardizacion de los Terminos 'A la Vista,' 'Probable,' y 'Posible' en la Cubicacion de las Minas," by R. B. Elmore; "Cubicacion de los Minerales In Situ," by R. Waisberg; "Comparacion Entre los Sistemas de Explotacion por Enmaderacion y por Contrafronton," by R. B. Elmore; and "Safety Methods for Modern Mines," by Dean Edward Steidle. The milling commission was presided

(*Continued on page* 133)

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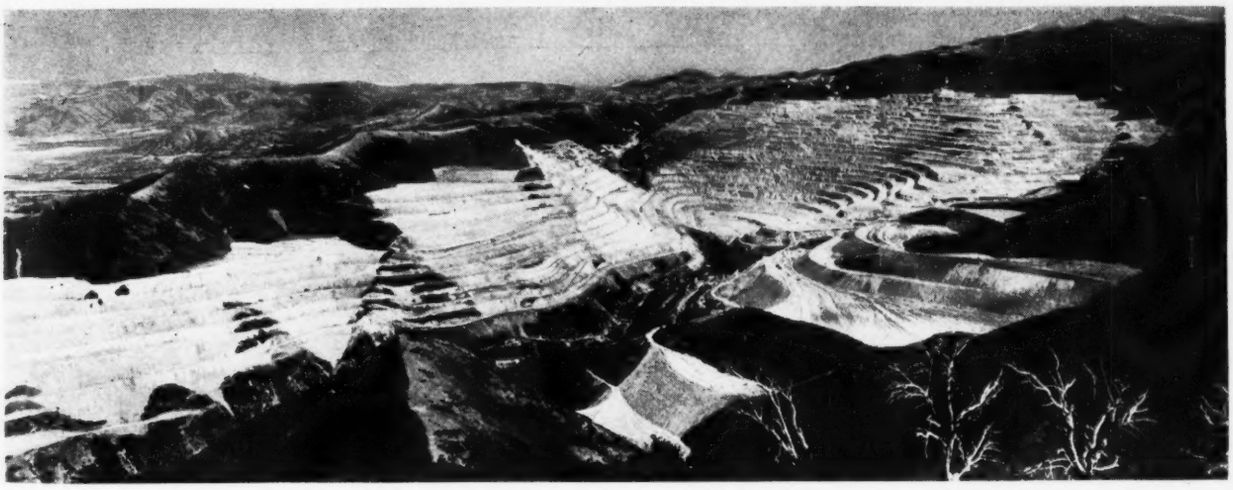

The Utah Copper Company established a new record in production during 1941 from its open pit copper mine in the Bingham district Utah

UTAH

New Park Mining Co. Sinking New Shaft

Exploration program also under way—Utah School of Mines will graduate engineers in April instead of June

▶ The New Park Mining Co. is sinking a three-compartment shaft from the Mayflower tunnel level while carrying on regular production. A diamond-drilling outfit has been purchased to assist in exploration. New Park Mining Co. ores carry gold, silver, lead, zinc, and copper. W. H. H. Cranmer, of Keetley, Utah, is president and general manager. The company is also opening its Gold Queen property. Tom Costas is foreman.

▶ In order to make more engineers available for industry, the University of Utah School of Mines has accelerated class work so that students will graduate during the latter part of April instead of early in June, Professor Robert S. Lewis announced recently.

▶ The Mountain Mines Co. in Mineral Fork, Big Cottonwood Canyon, is driving a crosscut to get around a caved area. C. S. Woodward, Beneficial Life Building, Salt Lake City, is general manager.

▶ Tests have been made of the scheelite deposits in Beaver County for the United States Vanadium Corp. by Alex Ranson. The Prosper Mining Co. is operating a mill near Milford. Ore is being mined from the Old Hickory deposit by Charles H. Segerstrom, Nevada operator.

▶ The first shipment of ore from the New Cashin Mines, Inc., situated just over the Utah-Colorado line from LaSal, Utah, carried 51 oz. silver to the ton and 6 percent copper, according to George H. Ryan, Dooly Block, Salt Lake City, company engineer. The company is re-equipping its 100-ton mill to treat a deposit of low-grade ore developed previously on the main tunnel level. Ore is hauled 87 miles to the railroad loading point at Thompsons, Utah, for shipment to a Salt Lake Valley smelter.

▶ A preliminary forecast of Utah metal production during 1941, made by George E. Woodward and Paul Luff, of the U. S. Bureau of Mines Intermountain Station at Salt Lake City, indicates that the $95,383,037 total will exceed the yield of 1940 by 10 percent. The year's output is only slightly below that of $95,985,201 for 1929 and $4,000,000 less than that of 1917, when an all-time high of $99,328,155 was attained. Greater production of the Utah Copper Co. at Bingham, which was producing 88,000 tons of ore daily at the end of the year, was responsible for the state-wide gain, as the output of gold, silver, lead and zinc declined.

▶ The Bingham district, says the report, produced 84 percent of the State's total; Park City, 8 percent; and the Tintic district, 4 percent. The Tintic district shipped 5,826 carloads of ore during the year, an increase of nearly 900 carloads over the 1940 record, but the metal content of the ore was lower. Much of the tonnage was from mine dumps where no new ore was being produced. Tintic Standard, Chief Consolidated, and Mammoth mines were the largest shippers.

CALIFORNIA

Prospecting Under Way On Chrome Deposits

Greater activity expected in spring—Small gold mines having difficulty in obtaining supplies under priorities

▶ Larger gold dredging and placer operating companies where adequate supplies are maintained are operating without special difficulties from priorities, but some of the smaller companies are having difficulties and many are unable to obtain supplies and replacement parts. Interest is developing in chrome, manganese, and tungsten and much activity in prospecting for promising properties is under way. Chrome ore discoveries are being reported locally, but at some properties winter snows are preventing exploration. The release of new specifications for the purchase of chrome ores will play a part in stimulating production of small lots of chrome ores. Recent rains have caused hydraulic mines in Trinity County to resume operations, with prospects for a long season with ample water.

▶ A Nevada City, Empire-Star Mines announces the closing down of the Murchie gold mine after unsuccessful exploration work for new orebodies.

▶ A recent survey indicates some 2,370 men employed in the mines of Nevada County, a slight decrease from the 2,400 reported in November. Empire-Star employs close to 1,000 men and Idaho-Maryland 880; other mines are the Lava Cap, Scotia, Omega and Relief Hill.

▶ A 100-ton amalgamation and flotation mill was recently completed at the Niagara mine of the Lincoln Gold Dredging Co. near French Gulch, and operations have been started on dump ore.

▶ A bucket line dredge has been placed in operation at the Poverty Hill mine, in La Porte district. Army Adams, of Grass Valley, is superintendent.

▶ Lincoln Gold Dredging Co., headed by Walter K. Jansen, of Lincoln, Calif., and E. M. Clark, of Yreka, Calif., has completed installation of its new 100-ton capacity flotation-amalgamation mill on the old Niagara property 6 miles west of French Gulch, Calif. Paul A. Bundy, mining negineer of Nevada City, Calif., is superintendent of mill construction. The mill will treat old dump ores on the property. Transport will be approximately a mile by dump trucks to the mill. Metallurgical tests have shown that about 80 percent of the gold values in the semi-oxidized dump ore can be recovered by amalgamation. In addition, a flotation concentrate will be produced. Treatment through the mill will consist of crushing to 1 in. with a 9x16-in. Universal jaw crusher, feeding of crushed ore by belt feeder to a 5x5 ft. Miners Foundry ball mill operating in closed circuit with one 24-in. Southwestern Engineering jig and a 16x4½-ft. Dorr type duplex classifier with the relatively large volume of jig concentrate going to Denver cleaner table,

(*Continued on page* 116)

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Reflections from Washington

By Special Correspondent

REORGANIZATION of official Washington for the war effort advanced materially during January. The new top agency is War Production Board, of which the chief is Donald M. Nelson. This agency is more than a planning and advisory board. It has practically the full authority of the President and all of the responsibility for getting things done.

Both the Supply Priorities and Allocation Board and the Office of Production Management were abolished with the formation of WPB. But the planning functions of the former and the survey and administrative responsibilities of the latter were continued, generally under the same personnel as were formerly in charge. The shift is, however, more than a new organization chart with shorter lines of authority. It is now a business body with a job to do and no question as to its right to give orders.

Transfer of William Knudsen from OPM to be a Lieutenant General in the Army has generally resulted in compliment about Washington. The shift has two apparent advantages. It frees Mr. Knudsen from conference and advisory and planning duties, so that he can give his full time to getting production for the military forces. In the second place, it puts into the Army a man whose ability will be respected, and whose orders must be obeyed by all subordinate units and officers. Seemingly, most Army men welcome this centralization of authority within their group permitting them to do business with the utmost vigor.

Domestic Manganese

DEFINITE ANNOUNCEMENT has been made of one new project to recover a high-grade manganese sinter from a low-grade domestic deposit near Las Vegas, Nev. The proposal is a mill which can handle 1,000 tons daily of crude ore sufficient to yield 300 tons per day of 60 to 65 percent manganese sinter or nodules.

This project, which will be operated by the Hanna organization of Cleveland, was tried out in a semi-works plant with Government cooperation. It utilizes sulphur-dioxide leaching of the ore. The reserve being worked contains enough 20 percent manganese ore to last several years.

Similar projects have been proposed for several other domestic deposits, including those of the Cuyuna range. There and elsewhere, one of the difficulties is to determine which of three types of process will be utilized. With the SO_2 leach there is difficulty because corrosion-resistant steel is required. When the ore lends itself to leaching with ammonium sulphate, there is the problem of securing ammonia for this purpose. These factors have to be weighed in contrast with the generally claimed lower efficiency of pyrometallurgical procedures. Those processes are handicapped because they require much heavy machinery, much refractory, and may be subject to high cost and low recovery.

Scarce-Metal Allocations

PRODUCTION OF FOOD and fibers by American agriculture is so important that special effort has been made to stimulate 1942 production. Necessary quantities of critical materials have been allocated for the manufacture of farm equipment.

It is estimated that this program will restrict the manufacture of new farm machinery this year to about 83 percent of the material used for similar purpose in 1940. However, repair parts are to be generously provided, probably at an average rate of 150 percent of the supply of such repair parts in 1940. It is believed that if farmers generally utilize repaired machinery as far as possible, there will be no difficulty affecting the agricultural program under this metal assignment.

Comparable plans of metal allocation for other big industrial groups are, of course, prepared or being prepared at this time. The extent of necessity for military and essential civilian work is the sole measure applied in determining the size of each use authorized. The extremes to which the curtailment program go has been very evident to all from the complete elimination of normal manufacture of passenger automobiles. Numerous other equipment and machinery industries have been cut off completely so far as civilian usage is concerned.

Explosives Licenses

DURING JANUARY the Bureau of Mines began to administer the new law providing for the licensing of all those who manufacture, market, or utilize explosives or certain important ingredients of explosives. The first set of regulations were published officially in the Federal Register of Jan. 16. (Copies are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10c. each). Those requiring a copy of the Act governing the licensing operations should secure a copy of Public Law 381 of the 77th Congress. (This also is available from the Superintendent of Documents, at 5c. per copy).

Each mining company requiring explosives will get a purchasers' license, described in the regulations as follows: "This license authorizes the purchase, possession, and use of explosives and ingredients. It permits no disposition of the explosives or ingredients purchased except the use thereof by the licensee."

Each employee of a mining company who has supervisory charge over storage or issue of explosives will get a foreman's license. "This license authorizes the purchase and possession of explosives and ingredients and the sale and issuance thereof to other employees of the licensee's employer, for use on the operating premises." It is not required that the individual miner, who simply procures his supply of explosive from day to day, be individually licensed. However, all of those whose duty includes issue or supervision of use do require licenses.

The responsibility for carefulness and dependability of individuals rests with the management of the company whose business is served by both licensed and unlicensed persons handling explosives. The prime consideration is, of course, to prevent loss or diversion into channels which might result in sabotage or danger to the public during wartime.

Companies or individuals requiring further information should be able to get instructions and to do most of their business with the licensing offices which the Bureau of Mines plans to establish at strategic points throughout the country.

Hemisphere Program

AT CERTAIN STAGES, the joint war production plan for the Western Hemisphere included the following major projects:

1. Removal of all tariffs and other trade barriers restricting essential goods movement among the cooperating nations.

2. Creation of an exchange arrangement practically amounting to a new international currency to finance trade, not only between the Americas but also with Great Britain, China, the Dutch, and certain other of the United Nations.

3. Establishment of a labor exchange to provide more skilled labor offsetting shortages.

4. Pooling of transport facilities with promise that certain Latin nations would get promptly greater supplies essential for well-being or comfort in those countries.

It is not determinable at the end of January whether the Administration will submit such a program to Congress for new legislation, or whether any treaties containing these ideas, developed at Rio, may be sent up for Senate approval.

Advocates of this cooperative program feel that it would make management of war programs easier. But those opposing it think it would establish virtually a "free-trade" basis for mining and agricultural commodities.

Salvage Campaign

THE SHORTAGE of iron and steel, non-ferrous metals, rubber, burlap, and other scarce materials can be partly offset by general industrial cooperation. The conservation executives of W.P.B.

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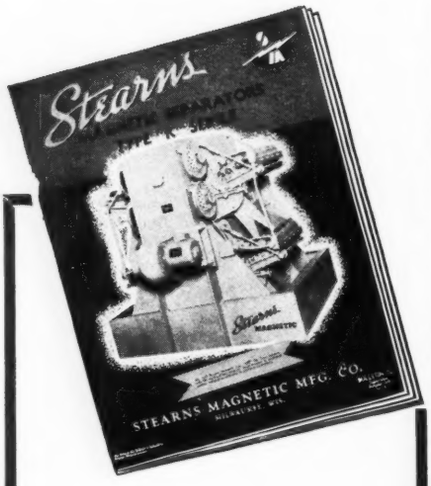

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▸REFLECTIONS

are, therefore, organizing salvage campaigns. The mining industry is urged to take an important part.

It is believed that many thousands of tons of scarce materials could be made available if each local management would assign competent personnel to survey all of the properties of the mining, milling, and smelting industry. Obsolete equipment, unneeded material in stockrooms, and discarded machinery and parts should be gathered. It is urged that not only iron and steel, but also rubber, burlap, and other scarce materials be brought together. It does as much good to turn this material over to a local scrap dealer as it does to put it into official channels. These dealers are working under regulations that insure prompt handling and flow into salvage and secondary material stocks.

Where any substantial quantity of an unusual material is available, it is suggested that those acquainted with the peculiar properties and usefulness of such goods be consulted. This is necessary in order that scrap be classified properly and its recoverable values be promptly realized.

Official Washington hopes that this operation can be made sufficiently profitable to induce complete coverage and thoroughness throughout the mining industry.

Incendiary Fire Control

FIGHTING MAGNESIUM FIRES in production plants has been studied by the U. S. Bureau of Mines at its Pittsburgh station. A novel method of extinguishing flaming metal was developed which appears to have very wide possible application. This method is applicable to fires started by small incendiary bombs dropped from aircraft, and for certain other types of fire-fighting in any division of industry, or even in the household.

"The extinguishing agent used is a very hard coal-tar pitch (approximately 300 deg. F. softening point), sometimes commercially designated as 'fuel pitch.' The size of pitch recommended for this use passes a ¼-in. mesh sieve and is coarser than 35 mesh; particles finer than 35 mesh should not be used. When spread over a hot magnesium fire the pitch softens and seals the burning magnesium metal with an airtight blanket, thereby smothering the flames. The pitch is nonabrasive, easily available, and cheap."

When the fire is on metal or dry concrete or dry ground, the pitch is spread (do not throw) with a long-handled scoop or shovel. If the first application is not enough, supplemental applications will quell the blaze completely. After the fire is extinguished, the mass is allowed to cool and can then be rolled up like a carpet or removed from the surface on which the fire took place. If the fire is initially on a wooden floor or wet ground, a little more care is necessary. A small amount of pitch is first spread on the fire to reduce the heat and glare. Then, more pitch is spread alongside the burning mass which is then rolled over onto this pitch to complete the smothering.

If the adjoining floor or structure is ablaze before fire-fighting can begin, the customary methods of fighting such fire may be used. But great care should be taken to avoid throwing in a solid stream either water or any carbon tetrachloride extinguisher onto the magnesium. A water spray helps and certain other foam extinguishers may assist in restraining the fire, but cannot safely be applied directly to the blazing metal.

News "Fines"

Pan American Delegates—The official American delegation to the first Pan American congress of mining engineering and geology at Santiago, Chile, Jan. 14 to 25, were: Elmer W. Pehrson, chief of the Technologic Branch of the U. S. Bureau of Mines; Donnel F. Hewett, geologist of the U. S. Geological Survey; and Charles Will Wright, who works with a roving commission in Latin America for the Coordinator of Inter-American Affairs of the State Department.

Plan for Welding—Because welding instead of riveting often saves metal, this procedure of fabrication and repair is being urged. The Bureau of Standards has investigated methods of substitution of welding technic and points out certain important precautions to be taken in adopting it. Novel designs are often necessary to secure good welding, and the maximum economy in metal. Not all metals are welded in identical manner and choice of metal is sometimes dictated by the available welding technic. Special care in welding of high-tensile alloy steels is achieved by adopting methods specifically adapted to these materials.

Draft Deferments—Very few permanent exemptions are likely to be granted to employees on the score of necessary employment, especially for young men under 28. All divisions of industry are, therefore, being urged to prepare substitute personnel ready-trained at the end of the six-month deferment period sometimes granted. It is emphasized in Washington that deferment is NOT permanent exemption.

Nazi Minerals—A special report has been prepared and issued by the Bureau of Mines summarizing "Germany's new mineral position," by Charles Will Wright. Those whose activities are affected by strategic metals and minerals will be supplied on request to the Bureau, with a copy of this report, which was released Jan. 19.

Non-Defense Budget—Non-defense activities of the Government which cost approximately two billion dollars per year would be cut off or greatly curtailed if Congress adopts the report of the Joint Committee on Reduction of Non-Essential Federal Expenditures. Most Washington observers are not optimistic as to the economies which will be achieved in practice. There is, however, evidence that careless spending by defense agencies is going to be more closely supervised. Any economy which can be achieved without slowing defense will be in demand.

Fuel Stocks Needed—The mining industry is being urged to build up and maintain fuel reserves at each strategic

point. These may be necessary if the pressure of traffic on the railroads occasionally interrupts for days, or perhaps weeks, normal transport of coal. The increased demand for goods movement to the West Coast has changed materially the fuel supply possibilities of the Rocky Mountain states.

New Specifications—The Government is urging that everyone bring in more recommendations regarding substitute specifications to use the less-scarce metals in place of those most needed. Hundreds of Government purchase specifications have been so shifted to eliminate the burden on nickel, copper, brass, bronze, aluminum, etc. Those who can recommend alternate materials, even those which they themselves produce, will be listened to attentively. The only restriction is that Government purchases must be of a quality that will not unduly interfere with military usefulness.

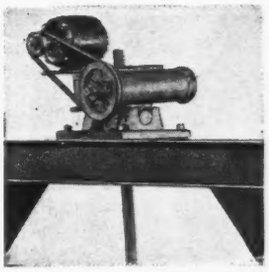
Labor Gains—Where desirable to secure labor peace, Washington may insist that labor be given certain additional share in management authority. Copper industry conferences to that effect have been freely forecast during January.

Non-Metallics Inquiry—The U. S. Bureau of Mines is making another review of need, supply, and possible shortage of non-metallic minerals. In this case the review is starting from the ultimate products end and working back through manufacturing processes to raw material. By this procedure it is hoped that large increases in needs will be identified promptly and impending shortages discovered. Where shortages are indicated, steps will be taken to advise regarding possible substitution, economy, and other needed adjustments.

Molybdenum Use—It is expected that the users of tungsten and molybdenum will be required more or less indefinitely to take three-quarters of their alloy requirement in the form of molybdenum except for government high-speed tool steels. Earlier in 1941 the required ratio was 50-50. But at the end of the year 75 percent of the orders accepted had to be of the molybdenum type.

Silver for Guns—The use of silver as a corrosion-resistant material is getting practical application by the Ordnance Department. Varying amounts are used in the recoil mechanism of many types of artillery. About 9.5 lb. of silver is used for each 150-milimeter gun and each 8-inch howitzer, for example. As silver is one of the least scarce metals, relative to normal demand, the development of further uses of this sort is expected.

Priorities—Priorities Regulations No. 3 issued late in January simplified the assignment and extension of individual preference ratings. Two new forms of Preference Ratings, Certificates PD-1A and PD-3A, replaced the forms PD-1 to PD-5 inclusive. Use of the new forms is optional after Feb. 2, but mandatory on and after March 1. The amount of paper-work saved and the elimination of duplicating priority applications on materials at various stages of fabrication for the same order as a result of the new system makes the alteration a fundamental one in priorities procedure.



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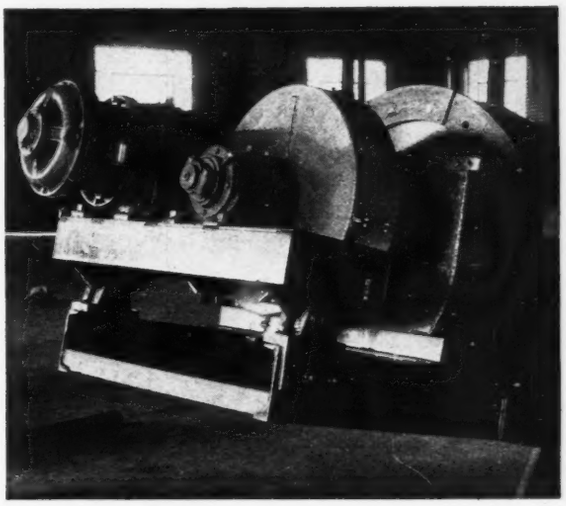

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▶CALIFORNIA

from which the high-grade concentrate will go direct to continuous amalgamation barrel and returning the middling to the classifier-ballmill circuit. Classifier overflow will be maintained at about 25 percent solids and 95 percent minus 160 mesh and will flow to four Fagergren flotation cells with a cleaned flotation concentrate being pulled from No. 1 cell and going direct to continuous amalgamation. Rougher flotation concentrate from Nos. 2, 3, and 4 cells will be recirculated to No. 1 cell by a 1-in. Deming sand pump. Considerable experimenting was done to find a flotation reagent combination that would yield a good recovery and not interfere with ready amalgamation of the concentrate. The following reagents gave excellent results: Pentasol Xanthate, Reagent 637, B23, Reagent 208, Reagent 404, and Soda Ash. Amalgamation of concentrate was readily made with pregrinding wash and soda ash treatment.

▶A 70-ton flotation plant was placed in operation recently at the St. Jude mine, near French Gulch, Shasta County, by A. Robillard, owner and operator. The property adjoins the Washington mine, and is opened by a 2,000-ft. adit in which several veins containing commercial ore are under development. The mill was designed and built by T. Eddinger of the Fabrication Service Co., of Nevada City.

COLORADO

Copper Vein Being Mined in San Juan County

Summitville Consolidated Mines, Inc., a gold producer, finds a copper vein worthy of exploitation—Resurrection mill, near Leadville, completed

▶The discovery of a copper orebody in the Summitville Cons. Mines Co., at Summitville, may prove of great importance to the San Juan region. The geology on a gold-copper zone was recently worked out by Edward Thornton, general manager, who is now actively developing the copper orebody with a marked degree of success. He states that the present indications point to a substantial body of copper ore. The Summitville mines have been operated mainly as gold-mining properties for 50 years, and no shaft or tunnel had ever cut through the copper-bearing ores which were believed to exist. These copper-bearing ores were cut by a tunnel which was being driven for transportation use. The waters from the Big Reynolds Tunnel have for many years carried a heavy solution of copper, and the iron pipes left in the Reynolds Tunnel from early days are almost filled solidly with cement copper. Experiments have proved that the copper ore can be handled at the Summitville mill, in the flotation section. Summitville Cons. Mines, Inc., treating 150 tons in the cyanide mill. About 140 men are employed.

▶The Hecla and the Newmont Mining companies have completed the new 250-ton pilot milling plant at the Resurrection mine, near Leadville. The mill is now ready for operation, and the development work in the mine has produced some excellent ore for milling operations. This property is an important additional producer in this section of Colorado.

▶Two new stationary compressors and a portable compressor and electrical equipment will be installed in the Rico Argentine Mining Co. property at Rico. The company is reopening parts of its newly acquired Pelleyre property, which comprises some 270-odd claims covering about 1,500 acres. The company negotiated a lease with the St. Louis Smelting & Refining Co., to use the shaft and to mine ore in St. Louis ground adjoining Rico Argentine property.

▶A. F. Woodward, one of the first important operators in the Cripple Creek district to be effected by the drainage through the Carlton Tunnel, is working through a winze from the ninth level, which is the bottom of the mine, formerly full of water. Many surface improvements have been made at the El Paso mine. This property, which was taken over under option in March, 1941, by Tom Copeland and Jim Knight, mining engineers from Chicago, has been worked steadily since that time.

▶J. O. B. Keener, mine superintendent of the Stratton Cripple Creek M. & D. Co., shipped 41,000 tons of ore from its 600 acres of mining properties in 1941. This ore averaged $9.71 per ton. About 4,000 tons of ore with an average value of $20.67 was shipped from the Longfellow mine of the Stratton Co. W. K. Howard, representing a group of Boston men, has been mining good ore on the second and third levels where an orebody eight to ten feet wide was cut. The Logan mine, leased to A. B. Cobb and operated under the direction of Lynn Richmond, cut into an oreshoot on the second level, believed to be the Logan Vein.

▶Development work has been started by the Golden Conquerer Mines, Inc., on the American Eagles property on Bull Hill, recently leased from the Stratton interests. A deMarconnay, of Manitou Springs, president of the company, also holds portions of the Acacia Gold and the Free Coinage properties.

▶The Cresson mine, at Cripple Creek, shipped 17,451 tons more of ore to the mill at Colorado Springs during 1941. Total ore produced by the Cresson to date is 3,094,845 tons, with a total gross production of $45,174,600; and dividends were over $13,000,000. The Hansen & Co., lease on the tenth level made a shipment that netted over $22,000. Preparations are being made to resume work on the 19th level, which was under water from 1929, and which was cleared of this water on completion of the New Carlton tunnel. About 200 men are employed.

▶The Winburn Brothers, of Salida, have shipped 200 tons of vermiculite, an insulating non-metallic. The mineral is being mined from deposits on Green Creek, just off the Monarch Pass Road. mining being carried on during good weather.

▶The Minnesota Mines, Inc., operating mines and a 250-ton mill at Empire, was

the largest gold producer in Clear Creek County in 1941. Ore is treated by concentration on mats in launders, and flotation followed by cyanidation of the flotation concentrates. Mr. Clifford, in charge of operations, employs about 125 men and has a yearly expenditure of labor and supplies of around $200,000.

Selective Service and The Mining Industry

IN A RECENT CONFERENCE between a representative of *E.&M.J.* and Brig. Gen. Lewis B. Hershey, director of Selective Service, the following statement was authorized by General Hershey for transmittal to the mining industry. Employers should read it carefully and take necessary precautions against unexpected loss of personnel in the draft. General Hershey states:

"Most of the actual combat fighting in this war will be done by the young men of America. Modern warfare is of such a nature that it requires the greatest in physical stamina, coordination, and reflex action. Generally speaking, the fitness of men for modern combat service is in inverse ratio to their age.

"Under recent legislation, more than 26,000,000 men between the ages of 20 and 44, inclusive, are liable for military service. There are an additional 13,000,000 men 18 and 19 years of age, and 45 to 65 years of age, who are to be registered. This gives America a total manpower of some 41,000,000 of men who must do the tasks that are necessary in total war for total victory.

"Selective service in total war is not going to deviate from the fundamental principles which governed its operations during the peacetime training program. Men will continue to be deferred from military service when they have dependents. Men will continue to be deferred from military service when they are 'necessary men,' and are difficult or impossible to replace.

"However, management and industry must recognize that the man who is deferred as a necessary man is deferred temporarily and each employer has the responsibility to secure and train replacements for such deferred men who are physically fit and would otherwise be available for military service. Occupational deferments are usually for a six-month period. When absolutely necessary, such deferment may be continued for additional six-month periods, but only where their continuance in the present job is absolutely necessary for the maintenance of our national health, safety, and interest.

"There is an adequate supply of replacements for necessary men among those who are physically unfit for military service, those who are presently deferred because they have dependents, those who are above the ages liable for military service—45 to 65—and in many cases among the women of this country.

"Employers must be honest and sincere in their requests for deferments and must limit such requests to cases of men who are in fact necessary. No industry or activity, no matter how closely identified with national production for war, can ever become a refuge for those who seek to avoid their obligation to their country in its hour of need."

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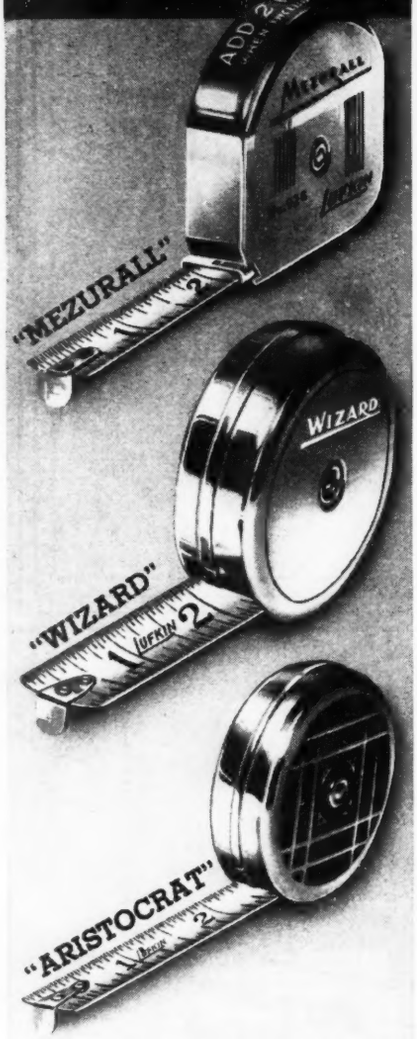

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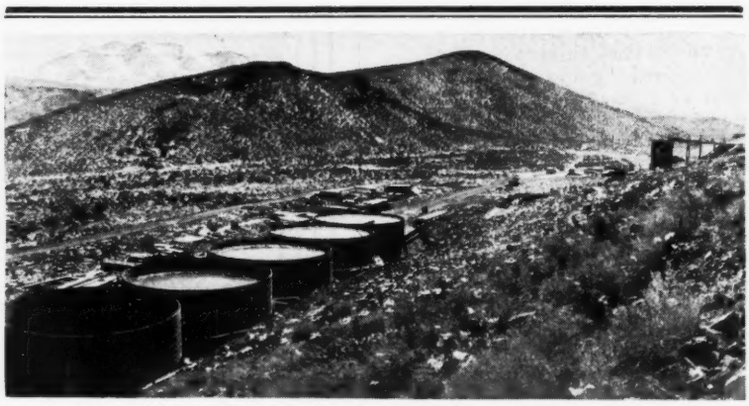

The Marigold Mines, Inc., is completing the erection of this group of leaching tanks as a part of its new mill now under construction. Mine production averages about 200 tons of gold ore per day

NEVADA

Activity at Many Mines Increasing

Base-metal and other producers had busy year in 1941 and greater output is forecast for 1942

▶ Activities in the Nevada field in 1941 were notable for new mill construction and expansion of existing plant capacity, and for substantial increase in production of copper, zinc, lead, and silver, with a small decrease in output of gold, compared with totals for the previous year. All major gold producers maintained or increased their earlier rate of output, but no new gold mines were opened to production and there was a pronounced decline in the number of small producers.

▶ Plant construction completed in 1941 or near completion at the year's end provides new capacity of around 2,000 tons per day and enlargements add some 700 tons. The figures do not include the 1,400-ton tailing-treatment plant of Bradshaw Syndicate, Inc., moved from Goldfield to Millers and to resume operating shortly. Several tungsten mills also are excluded.

▶ Two productive mines with mills were closed down in 1941: the gold-silver mine and 50-ton cyanide mill of the Penelas Mining Co. in northern Nye county and the gold mine and 100-ton cyanide mill of the Chiquita Mining Co., Ltd., near Goodsprings in Clark County. Both reported exhaustion of ore.

▶ In the Pioche district, Lincoln County, the Combined Metals Reduction Co., controlled by the National Lead Co. and largest Nevada producer of lead-zinc-silver ore, completed and operated a 500-ton selective-flotation mill at its Caselton mine, treating, with its own product, 120 tons per day of similar ore from near-by workings of its affiliate, the Prince Cons. Mining Co. E. H. Snyder, of Stockton, Utah, is manager.

▶ In the Adelaide district, southeastern Humboldt County, a 250-ton cyanide mill was completed and operated late in the year by the Adelaide-Crown Syndicate, headed and managed by Roy A. Hardy, 206 Virginia St. Reno, Nev.

▶ At the Copper Canyon gold-copper mine of the Copper Canyon Mining Co. in Lander County, the International Smelting & Refining Co., under an option agreement involving control of the former, at year's end had nearly completed a 400-ton flotation mill, was sinking a new deep shaft, and was sampling and prospecting, by development and drilling. J. J. Lillie, Battle Mountain, is in charge.

▶ At the close of the year a 400-ton cyanide mill was near completion on gold property of the Consolidated Goldacres Co. near the Tenabo district, Lander County. The new plant was constructed by the Western-Knapp Engineering Co. A. E. Moynahan, Beowawe, Nev., is manager.

▶ Early in the year Western-Knapp completed a 150-ton flotation mill for the West Coast Mines, Inc., at Barrett Springs, Humboldt County, and a substantial production of silver-lead-gold concentrate followed. Lately the working force was cut to 18 men and mill feed reduced from 4,000 to 600 tons per month, with the purpose of developing deeper levels and to prepare for delayed installation of sink-float equipment by the American Cyanamid Co. John F. Cowley, Winnemucca, is in charge.

▶ In southeastern Humboldt County near Valmy, the Marigold Mines, Inc., has been building a 200-ton cyanide mill and shipping 100 to 200 tons of gold ore per day to the Adelaide-Crown custom mill and to the Kennecott smelter at McGill. Lou M. Louis is construction engineer and Frank E. Horton, of Winnemucca, is president and manager.

▶ The Getchell Mine, Inc., continued by a wide margin the largest Nevada gold producer, its cyanide mill in the Potosi district, eastern Humboldt county, treating 1,000 tons per day of $6 to $12 gold ore. With an increasing proportion of mill feed coming from the sulphide zone, a second 7½x260-ft. rotary kiln was provided by the Traylor Engineering & Manufacturing Co. for the primary roast, to which sulphide ore is subjected before entering the cyanide circuit. A Cottrell precipitating unit was installed to recover arsenic. Noble H. Getchell is manager, Fred Wise superintendent, and Carl Wark mill superintendent. Their postoffice is Redhouse, Nev.

▶ In Eldorado Canyon, Clark County, the El Dorado Rover Mining Co. brought

capacity of its cyanide mill to 120 tons under direction of J. D. McPherson and similar capacity was attained by the Diamond Gold Mining Co., P. A. Simon, of Las Vegas, manager. The Ohio Mines Corp. increased millfeed to 60 tons per day at its cyanide mill in the Hornsilver district, Esmeralda County. Howard P. Clark is manager.

▶ The Rip Van Winkle Cons. Mining Co. has made additions to its selective-flotation mill in the Merrimac district, Elko County, and is treating 100 tons of silver-lead-zinc ore per day on two shifts, with the purpose of working three shifts in mine and mill soon. L. S. Breckon is in charge.

▶ In the Gold Circle district, western Elko County, the Esmeralda Gold Mines, Ltd., of Toronto, Ont., increased capacity of its cyanide mill from 30 to 60 tons per day, treating gold ore from its Esmeralda mine. H. L. Heath, of Midas, is manager.

▶ Tungsten production increased in 1941, the Nevada-Massachusetts Co. maintaining up to the year's end its rank as largest United States producer, treating 260 tons of scheelite per day in its mill near Mill City, Pershing County. Rare Metals Corp. mined scheelite from three properties for capacity operation of its tungsten mill at Toulon, Pershing County. Ott F. Heiser, of Lovelock, Nev., is in general charge. The Tungsten Metals Corp., with 150-ton mill at Shoshone, White Pine County, ranked second and the newly active Lincoln Mines Co. produced scheelite concentrate from a 50-ton plant in the Tem Piute district in western Lincoln County.

▶ Mercury production was maintained at around the 1940 volume in 1941, cinnabar mines with rotary or retort furnaces having operated with varying output in various districts.

▶ The M. A. Hanna Co., 75-year old iron-ore mining and shipping concern of Cleveland, Ohio, announces that its subsidiary, Manganese Ore Co., will begin immediate development of extensive Western manganese ore claims and construction of a pioneer treating plant, the first commercial plant of its kind in the country. The Hanna claims are in Clark County, 15 miles southeast of Las Vegas, Nev. About 100,000 tons of high-grade concentrate will be produced annually, with production expected by December 1942.

▶ An agreement has been entered into with Defense Plant Corp. and Metals Reserve Co. for the construction and operation of a large mill to treat the low-grade manganese found in these deposits. George M. Humphrey is president of the M. A. Hanna Co.

▶ Several carloads of antimony ore, all stibnite, in small lots from widely separated districts, were shipped to the smelter at Laredo, Texas. Barite deposits in Humboldt and Eureka counties were taken under option by the National Lead Co. Dumortierite was mined and shipped to the Detroit plants of the Champion Spark Plug Co. from Oreana, Pershing County. The American Metal Co., Ltd., acquired a large area at Pioche on which the E. J. Longyear Co. conducted deep prospect drilling. International Smelting & Refining Co. started drilling at Copper Flat, two miles west of Yerington, Lyon County.

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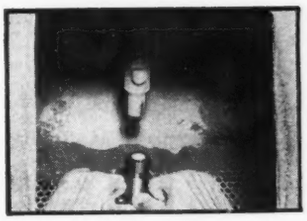

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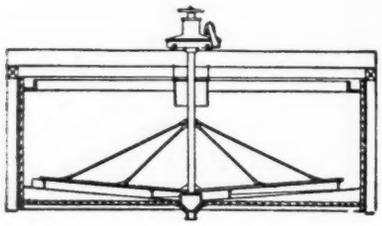

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The new 150-ton flotation mill completed recently at the Dayrock property in Nine Mile Canyon, near Wallace, Idaho, by the Day interests. Lead and zinc are the leading metals recovered

IDAHO

Large Mine Operators Adopt Seven-Day Week

Output of lead and zinc expected to increase soon—Threatened strike at Sullivan zinc plant averted

▶ Big mine operators of the Coeur d'Alene district have adopted the seven-day work week requested by the government in production of lead and zinc ores. Mills of the district will work on the same schedule if sufficient ore is available to keep them going. Miners will take one day off every two weeks, which will be on a Sunday change day.

▶ A threatened strike of 300 employees at the Sullivan Zinc plant at Kellogg has been settled by representatives of the company and the C.I.O. Mine, Mill and Smelter Workers Union. The new agreement is in effect to May 16, 1942, and provides for the voluntary check-off system, full seniority rights, vacations with pay for men employed more than four months, wage increases of 25c. per day, and additional wage increases of 25c. a day for each half cent increase in the price of lead above 5.85c.

▶ Sunset Leasing Co., operating the Anaconda's Clark mine on Sunset Peak, Coeur d'Alene district near Wallace, is working on a new vein of ore encountered about 30 ft. north of the main tunnel level. The vein is about 4 ft. wide and ore values have continued for over 100 ft. Stoping operations will get under way at once, adding to other stope output which is running around 100 tons a day.

▶ The Silver Banner Mining Co. has purchased the Banner silver property, near Idaho City, from Vivian A. Thorne, of Idaho City. Former development work included the sinking of a 685-ft. shaft from which point the new operations will be started.

▶ Callahan Consolidated Mining Co. has connected the old Rex mine workings with a raise started from the level of the Red Monarch tunnel at the head of Beaver Creek, Murray district, according to Joe Grismer, of Wallace, in charge of mine development. Production will be started from the old Rex workings of lead-silver ore.

▶ The crosscut from the 3,100 level of the Sunshine Mining Co.'s Jewell shaft, being driven into ground owned by the Metropolitan Mines Corp. under a working agreement between the two companies, has reached a length of 1,500 ft., according to R. S. Merriam, of Wallace, Metropolitan manager. Drifting will be started at a point about 400 ft. back from the present face, where numerous stringers of high-grade silver ore were encountered.

▶ The Rainbow property, near Salmon, Idaho, is being developed by a crosscut tunnel driven by Ralph M. Geumlek, of Salmon, representing the Equities Co. Work was suspended on the mine in 1938. A 25-ton amalgamation mill will be operated.

▶ Highland-Surprise mine, in the Pine Creek district, west of Kellogg, was the scene of an important ore disclosure early in January on the 300-ft. level of the Surprise shaft. The west drift showed 5 ft. of lead-zinc ore, 3 ft. of which is solid high grade and the remainder first class milling ore, according to Robert D. Bailey, of Wallace, engineer. Encouraged by new lead and zinc price increases the company will sink an additional 100 ft. on the Highland vein and 100 ft. on the Surprise vein, H. M. Hueman, Wallace, secretary-treasurer, announced. Milling operations will be resumed about April 1 with an increased output of 200 tons a day.

▶ A tungsten discovery made at Stibnite, central Idaho, less than two years ago may go down in history as the greatest mineral find in the State since the discovery of the Bunker Hill & Sullivan at Kellogg in 1884, according to Dean A. W. Fahrenwald, of the University of Idaho School of Mines. "That discovery possibly may come to be one of the greatest tungsten deposits on the continent," Dean Fahrenwald said, "and it couldn't have come at a better time, for we consume far more tungsten than we produce."

▶ The Coeur d'Alene mining district properties annually consume about 2,750,000 lb. of powder, 10,000,000 ft. of fuse, 1,500,000 blasting caps, and 150,000 electric caps, according to estimates of powder companies serving the district.

ARIZONA

Higher Metal Prices Encourage Activity

Small base-metal mines preparing to re- to increase output. Operations start at Morenci

▶ The new Morenci unit of the Phelps Dodge Corp. started operations Feb. 2, treating copper ore from the Clay orebody mined by open-pit methods. Two ball mills went into operation in the plant that has a capacity of treating 25,000 tons of ore daily. Annual production from Morenci is estimated to be around 75,000 tons of copper. Gilbert C. Davis is general manager.

▶ The Gold Standard, Inc., in the Katherine district 30 miles west of Kingman, in Mohave County, is operating its 250-ton mill steadily on ores from the Tyro mine, 6 miles distant. The ore is hauled with a 25-ton truck over a distance of 5 miles. Several thousand tons of ore are stacked ready for use in the mill during any emergency at the Tyro property. This guarantees steady operation of the mill. Richard de Smet, of Kingman, is managing director of the company.

▶ Producers, Inc., operating a 250-ton custom mill 7 miles west of Chloride, in Mohave County, is running steadily. Approximately half the mill supply of gold ore is now being hauled from the Golden Door property, 18 miles northerly from the mill. The remainder of the ores supplying the mill is coming from a number of properties in the district. H. W. Thorne is general manager of the Producers company. Postoffice address is Chloride, Ariz.

▶ Davenport Mining & Reduction Co. is operating its 100-ton flotation mill at the Oro Plata mine, in the Layne Springs area of Mohave County, and making regular shipment of lead-zinc concentrates to the smelters. The mill is operated mostly on custom ores, but active development in proceeding in the Oro Plata property, which will make available large tonnages of commercial ore known to exist in that property. Harry H. Hughes, of Kingman, is in charge of operations. Ogden C. Chase, of Las Vegas, Nev., is president of the company.

▶ Vivian Mining Co. is running about 60 tons of gold ore through its mill at Vivian daily. Two new stopes have been opened in the old Leland property, where mining has been under way for several months. The management reports that the capacity of the mill is to be increased to 100 tons per day. A. E. Kern, 110 Sutter St., San Francisco, is president of the company. A. E. Laitem, of Oatman, is manager of the property. Robert A. Elgin, of Kingman, is consulting engineer.

▶ Post Gold Mines, Inc., of Oatman, Mohave County, has taken over the Lost group of six claims situated a short distance from the famous Moss mine, in the Silver Creek district north of

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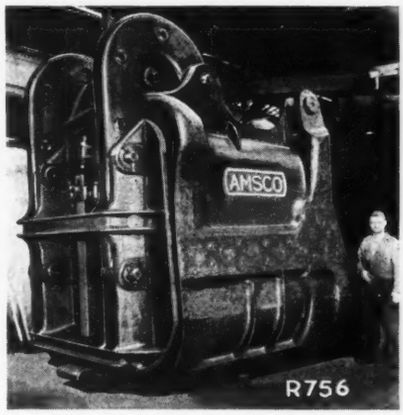

They're digging in for Defense—an Amsco 16 yd. Dredge Dipper recently shipped for harbor work (R756)—an Amsco 12 yd. Renewable Lip Dipper at an Illinois strip mine—a new Manganese Steel dipper front (R688) to renew an Amsco-Missabe 2½ yd. Dipper used in a road stone quarry. This type of dipper is widely used for the most abusive services.

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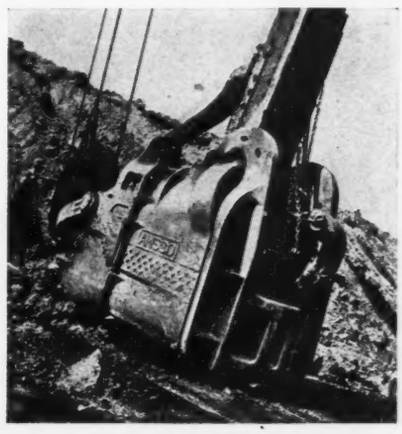

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▶ARIZONA

Oatman. The company reports an excellent showing, and development is planned. William M. James, of Oatman, is president of the company and J. H. Hoffman, of Kingman, secretary-treasurer.

▶G. H. Middleton, of Superior, Ariz., is screening the dumps at the Silver King mine and shipping the fines to a smelter. The property is owned by Bat Gays, of Superior.

▶The Silver Bell Con. Mining Co.'s property, 20 miles from Florence, has been taken over by G. T. Humphries, of Tucson, under the terms of a seven-year lease. The property closed down early in 1940 because of the low price of lead. Previous to that time it had been a steady producer of silver-lead ores. The mine is owned by the California Steel Products Co., of San Francisco.

▶Ore shipments have started from the Hardy mine, in the Ash Peak district west of Duncan. Operations are under the name of the Hardy Mines Syndicate, of Duncan. The 550-ft. shaft is being retimbered and an 125-ft. winze is being sunk. The property is operated by C. C. Streeter, of Phoenix; J. V. McConnell and William Amesbury, of El Paso, Tex., and Conrad Troll, of Los Angeles.

▶The Phillips asbestos mines, four miles from Seneca, in Gila County, is operating a small mill for grading the product. Forty men are on the payroll and the product is sold to the Johns-Manville Products Corporation. The mine is owned and operated by Guy G. Phillips, of Globe.

▶Control Mines, Inc., has purchased 20 lode claims in the Old Hat district on the north slope of the Catalina Mountains from the Phelps Dodge Corp. The company has been operating claims in the district for the past two years. It has a 100-ton flotation plant in operation and employs about 50 men. R. W. Adams is mill superintendnet and Newt C. Wells, of Oracle, Ariz., is general manager.

▶A. J. Klampt, of 2335 Virginia Road, Los Angeles, Calif., is cleaning out the old workings at the Aravaipa mine, near Klondyke, preparatory to an examination.

WASHINGTON

Pend Oreille Mines May Expand

Plans being discussed for a new mill in addition to one already in operation—Paternos gold mine reports high grade ore

▶Pend Oreille Mines & Metals Co., of Metaline Falls, plans to develop and put into production its subsidiary, the Reeves MacDonald property, by the erection of a mill of 2,000 tons' daily capacity, which it is said will cost approximately $1,000,000. Most of the holdings of the Pend Oreille company are on the Washington side of the international line, but the Reeves MacDonald holdings are north of the line. Whether the plant will be north or south of the line has not been decided. It is claimed Reeves MacDonald has 3,000,000 tons of developed ore which will produce 150,000 tons of zinc and 40,000 tons of lead. L. P. Larsen, of Spokane, president of the Pend Oreille company, as well as of its subsidiary, outlined plans for this construction at a meeting of stockholders of the Reeves company at Vancouver, B. C.

▶O. A. Thomas, mining engineer of Seattle, who is in charge of development of the Pateros gold mine, reports that a crosscut has been extended 50 ft. into a mineralized zone without passing out of it. The high grade on the footwall is 18 to 20 in. wide and the remainder of the vein carries $2 to $15 to the ton in gold.

▶Methow Gold Corp. continues to ship ore and concentrates from the Alder Group mine, near Twisp, Okanogan County. The returns on the crude ore ran from $390 to $1,084 to the car and on the concentrates from $1,952 to $2,252 to the car in gold. Mahlon McCain is manager, and Stenstrom brothers have the contract for mining the ore and hauling it to the railroad.

▶West Coast Mineral Association, of Seattle, has wired United States Senator Wallgren, of Washington, asking him to secure if possible an appropriation for trenching and drilling chrome deposits in the Twin Sisters sections of Skagit and Whatcom counties.

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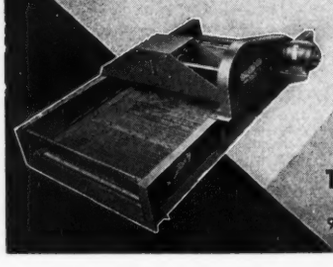

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▶ Rowland King, mining engineer of Spokane, is in charge of the manganese development and production of Sunshine Mining Co., at its property on Crescent Lake, on the Olympia peninsula. High-grade ore is being mined from the 117 and 217-ft. levels and stockpiled to fill a contract.

ALASKA

Good Results Had By Yellow Band Gold Mines

Development of gold and lead veins during brief season holds promise—Yukon Consolidated Gold Corp. reports slight decline in output for 1941

▶ Two planes, disabled, delayed Yellow Band Gold Mines, Inc., getting its work started for last year until June at its property in the northern part of the Territory. The company reported to stockholders at their recent annual meeting that a storage dam on Power Creek has been partly constructed, a camp installed with 120-cu. ft. compressor added during the year, and enough air provided for two drills. Before the season closed 50 ft. of crosscut was driven and 60 ft. of work done on the vein producing 262 tons of ore. The crosscut hit two veins at 60-ft. depth. The No. 1 vein carried much galena and a second vein had a gold content of half an ounce per ton. In drifting on the No. 3 vein, four to 18 in. of ore was opened that assayed well. Twenty-seven inches of width gave an average value of $50 per ton. The ball mill went into operation in July and continued until closed down by weather Oct. 7. The average value of mill heads was $46.45 and the recovery 97 percent. Bullion recovered amounted to $11,553.

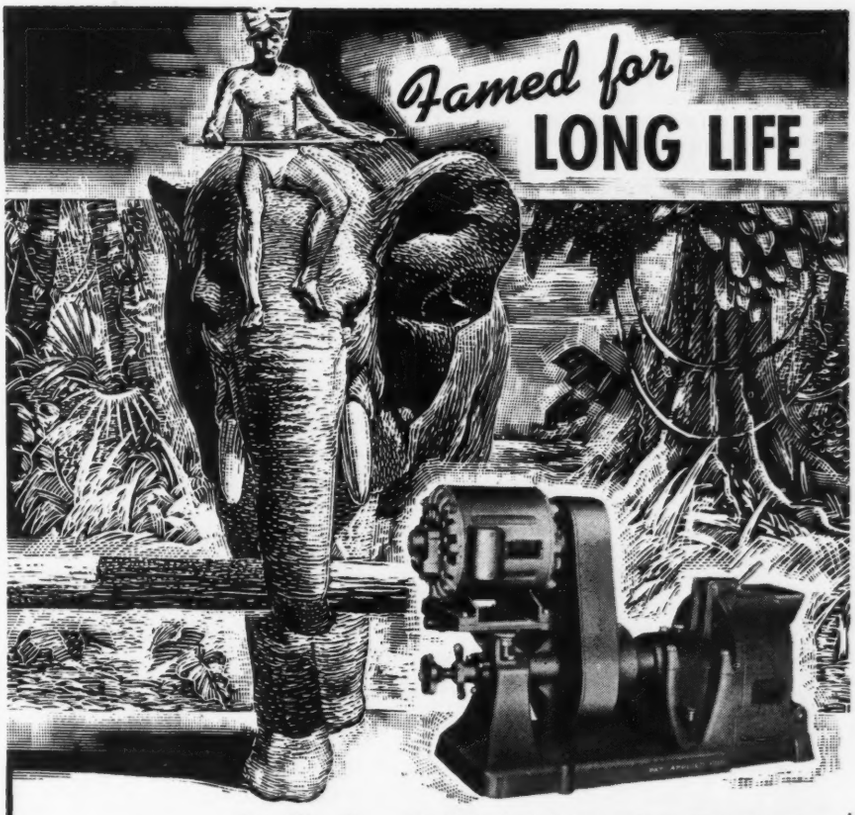
▶ Yukon Consolidated Gold Corp. had a production in 1941 of $2,325,000, compared with $2,621,000 in 1940, according to G. R. F. Troop, secretary. The operations are on the Klondike River and on Bonanza and Bear creeks. Difficulties encountered last year included a dry summer, followed by light snowfall in the winter, with almost no rain, which reduced stripping operations and the work of the dredges. The dredges shut down in November.

▶ Leo Saareka, in charge of the assay office at Anchorage, reports that there was no lessening of work due to war and that samples for testing continued to come in especially from the Willow Creek district.

▶ J. J. East, of the United States Bureau of Mines, has suspended for the winter the experimental drilling for nickel deposits on the high elevations on Yakobi Island. He has brought his men and pack horses into Juneau.

▶ Ed Harwood, of Platinum, reports that platinum mining in the vicinity of Goodnews Bay will be greatly expanded in 1942. Goodnews Mining Co. is operating the world's largest platinum dredge and several other platinum producers are in operation.

▶ William Oliver, in charge of operations of Ophir Gold Dredging Co., in the Council district, reports that five dredges were in operation in that region last year.



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IRON COUNTRY

Winter Work Making Rapid Progress

Large stripping programs under way and old mines are being rehabilitated for a new record in iron ore pitput

▶ The Iron Country is at present keeping pace with industry in an all-out effort for increased production of war materials. The final figures for 1941 production of iron ore show that all companies reached new peaks in ore shipments. The Oliver Iron Mining Co. shipped a total of 32,031,511 tons from the Mesabi range, with the Hull-Rust-Sellers mine alone producing 15,740,130 tons. The total shipments from all properties on the Mesabi range amounted to 59,379,725 tons—or 74 percent of the total ore shipped from the Lake Superior district during the past season.

Mesabi Range

▶ The year 1942 will see an even greater expansion on the Mesabi range. The United States Government is asking for over 89,000,000 tons this year. New ore carriers are expected to be placed in commission in June or July of this year. These can increase the total tonnage hauled by approximately a million and a half tons for the part of the year in which they will be operating. Cooperation between the iron ore producers, the railroads, and the vessel operators has always been the best and every effort will be made to meet the need for increased iron-ore movement.

▶ All present producing mines are being expanded for larger production in 1942, with heavy stripping programs being carried on during the winter months at all properties. Several new properties will be opened for 1942 production.

▶ Inland Steel Co., recently purchased the fee of the Dean mine, at Kinney, Minn., from George P. Tweed, of Duluth. This mine was first opened in 1915 and operated by the M. A. Hanna Co. No immediate plans for opening the mine have been made, but production can be started on short notice if required.

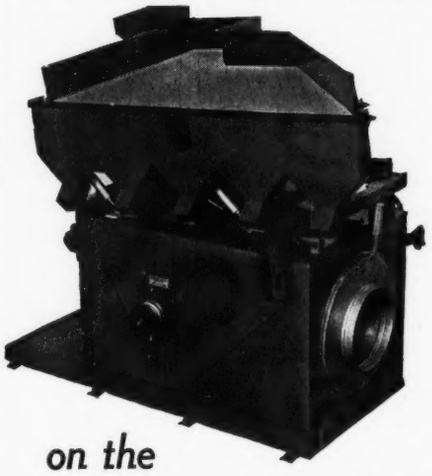
MICHIGAN

Old Copper Mine May Be Reopened

The Arcadian property, near Hancock, is being explored—Higher copper price is expected to stimulate new activity

▶ Now that the need for copper is paramount in the national defense program, the Chambers of Commerce of Houghton and Hancock, in the Michigan copper district, are interested in a project to reopen the Arcadian mining property. For the past two years the new owners, Cohodas & Paoli, of Houghton, have had a small crew at work driving an explora-

Air SPEEDS SEPARATION



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tory adit into Quincy hill on the company's property near Hancock. The adit is in 1,800 ft. and some crosscutting has been done. Five lodes of varying degree of value have been cut. It is the intention to continue the tunnel to No. 2 shaft of the Arcadian, which will be reached at the fifth level. The shaft then can be drained by gravity and mining operations started, providing needed machinery is installed. The work has been directed by Prof. W. A. Seaman, of the geology department of Michigan Tech. It is hoped some form of Government aid can be obtained with which to purchase machinery and enable the mine owners to reopen the property within the next six months.

▶ Officials of the copper-mining companies in the Michigan district were awaiting at this writing more information on the proposed 5c. per pound bonus for additional copper production. The bonus, according to Washington advices, will be paid on all metal over and above certain quotas to be fixed by OPA. It was reported that the 1941 production of each company would probably be fixed as the base. Seventeen cents per pound, Connecticut Valley, was stated as the new price. Companies already having contracts, however, on the basis of one cent above "out-of-pocket" costs, will be continue effective until such contracts expire. The government's new plan means an "all-out" program for copper production, the mine officials say, and a five-cent bonus would stimulate much new activity in the Michigan district.

TRI-STATE

Higher Zinc Output In Prospect Soon

Cold weather retards some work—Two high grade zinc ore strikes made near Joplin

▶ A ten-day cold wave in January reduced blende production for the first four weeks ending in the month to 31,696 tons, which compared with 34,860 tons for the corresponding period a year ago. The latter part of the month was marked by more favorable weather for operating conditions, and, with the stimulating effect of an $8.11-a-ton increase in the price of galena to $76.75 on a quoted metal contract basis, production was getting back to normal rapidly. However, toward the end of the month, district ore producers still were awaiting clarification of the government's plan of premium prices on above-quota zinc-lead production for 1942, based on last year's output.

▶ Two recent ore strikes were made in the immediate Joplin area recently. One is that of the Northside Mining Co. on northwest of Chitwood, where a new shaft was sunk about 400 ft. west of the old John Jackson mine—a fabulous producer and bonanza of 35 years ago. One of the richest zinc ore-bodies opened in the Joplin vicinity in recent years was tapped at the 160-ft level, which proved out churn-drill records of some time ago. The shaft was sunk 16 ft into the ore,

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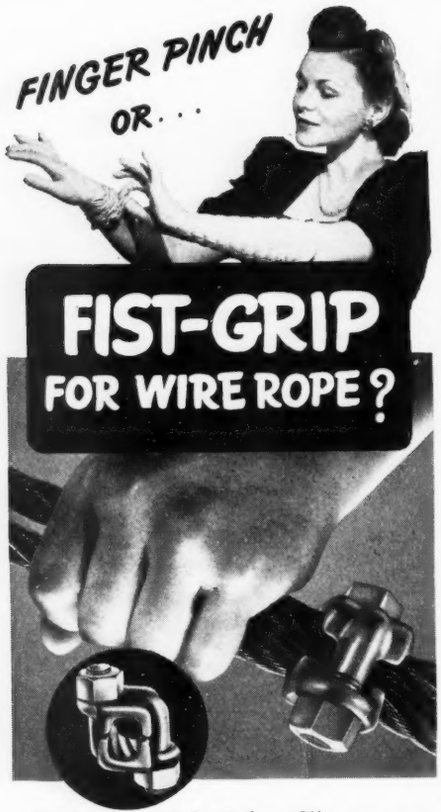

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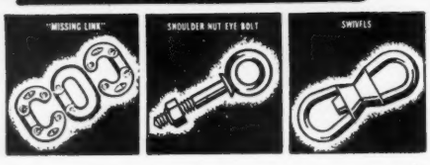

▶TRI-STATE

and approximately 75 tons of ore were removed, estimated to contain from 25 percent to 50 percent zinc. A 7-in. Pomona turbine pump has been installed in the shaft, and, with the installation of a 12-in. Peerless turbine pump at the High Grade mines on the adjoining lease to the south, further development of the new mine is expected to proceed on an expanded scale. George W. Moore of Joplin is in charge, with Jack Ferneau, of Joplin and C. C. Madison, of Kansas City. The other strike was at the Sunday mine of the Victory Mining Co., in the old Thoms Station mining area, about three miles north of the Northside mine, where a large slab of lead ore, weighing about 1,868 lb. was recovered. A lease on 15 acres was taken by the Victory Company last November, when the development work was resumed. Among those associated in the Victory company, besides Caulkins, is A. B. Reed, of Joplin. Alvin Mayfield is foreman.

▶ Beck Mining Co. is conducting mine operations on the 235-ft. level out from a shaft on the Effie Hurlbut land, two miles west of Waco, according to Dick Beck, of Miami, general superintendent for the company.

▶ Fred Childress & Sons have completed construction of a large hopper over the Bailey shaft on the Southside tract, west of Galena. The new equipment facilitates the loading of ore into trucks and its subsequent dumping into railroad cars at a new Frisco spur and unloading ramp built a few hundred yards north of the mine. Ore is being shipped to the Eagle-Picher Central mill in Oklahoma, for treatment.

▶ Rialto Mining Corp. has purchased the Lavrion Mining Co.'s mill at Douthat and has dismantled and moved it to Neck City, where the corporation plans to rebuild the 25-ton-an-hour plant on the site of the old Century Zinc Co.'s mining property, which, together with the old Lucky Tiger, Hill Top, Express and Long-acre-Chapman mining properties, comprises a 160-acre tract. In addition to its own mining and milling activities in the old mining camp, the Rialto company probably will do custom milling for shallow mine operations in the Neck City area.

▶ Eagle-Picher Mining & Smelting Co. has completed a new 70-ft derrick and 400-ton hopper at a new shaft put down last year on the Owen land, two miles northeast of Wentworth. The new shaft was sunk to the 106-ft level. The ore is being trucked to the company's Navy Bean mill, west of Wentworth, for treatment. A large steel derrick and hopper has been moved by the company from the John Beaver No. 3 mine shaft to the company's Central-Crystal No. 2 mine shaft, northwest of Cardin. The company also is sinking the old Inspiration shaft on its 160-acre Webber lease, north of Picher in Kansas. The mine shaft will be sunk 72 ft. deeper to the 329-ft level. It is situated in the north-central part of the lease, principally north of the Webber mill. The old Commerce Webber mines have been famous producers of zinc and lead concentrates over a 25-year period.

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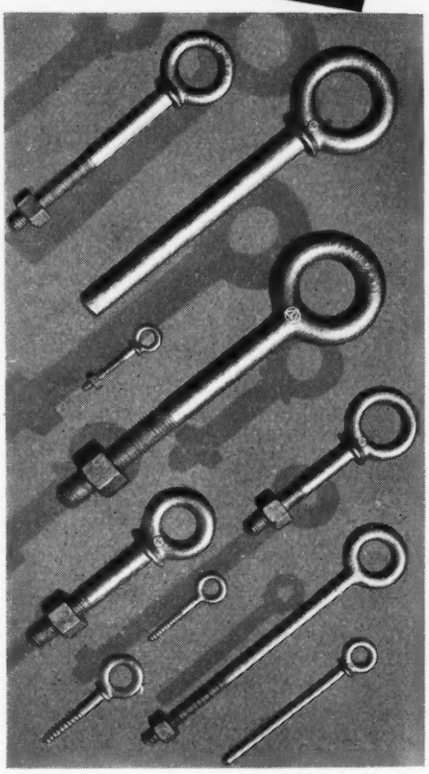

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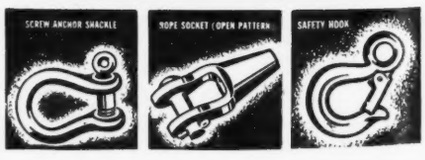


NEW YORK

Large Mill Will Treat Manganese Ore

Clifton iron-ore deposits in northern part of the State will be exploited for first time in many years

▶ In the pioneering of new ore fields, the first major development undertaken by the M. A. Hanna Co. for defense within the year was launched last August in northern New York State, where Hanna interests reopened the long-idle Clifton iron-ore deposits. Manganese Ore Co. plans call for early stripping of the open-pit area to accumulate an ore reserve that will be available when the 1,000-ton mill is completed sometime in 1942.

▶ The crude ore will be processed into 300 tons of 60 to 65 percent manganese ore nodules or sinter. Its great advantage is that blast-furnace operators can mix it with a low-grade manganese which cannot now be used in the making of standard ferro manganese, an essential requirement in steel. Perfection of the sulphur-dioxide refining process, a method of separating out the manganese, has been achieved for the Hanna company by the Pan-American Engineering Co., at Berkeley, Calif. The process involves several steps, including crushing, grinding, filtration, leaching, evaporating, roasting, and, finally, sintering or nodulizing the resultant manganese concentrate. Officers of the Manganese Ore Co. are George M. Humphrey, president; M. C. Lake, vice president; H. L. Pierce, vice-president; and W. A. Maier, secretary-treasurer. Mine development work has been supervised by M. C. Lake, San Francisco, and E. E. Hunner, general manager, Hanna ore mines, Duluth. Experimental plant technicians included R. S. Walker, consulting engineer, M. A. Hanna Co., Cleveland; D. N. Vedensky, chief metallurgist, Pan-American Engineering Co., Berkeley, Calif.; J. D. Sullivan, chief chemist, Batelle Memorial Institutte, Columbus, Ohio, and W. L. Badger, consulting division, Dow Chemical Co. The U. S. Bureau of Mines and the U. S. Geological Survey cooperated in the development work. The Manganese Ore Company is also interested in the Artillery Peak area of Arizona.

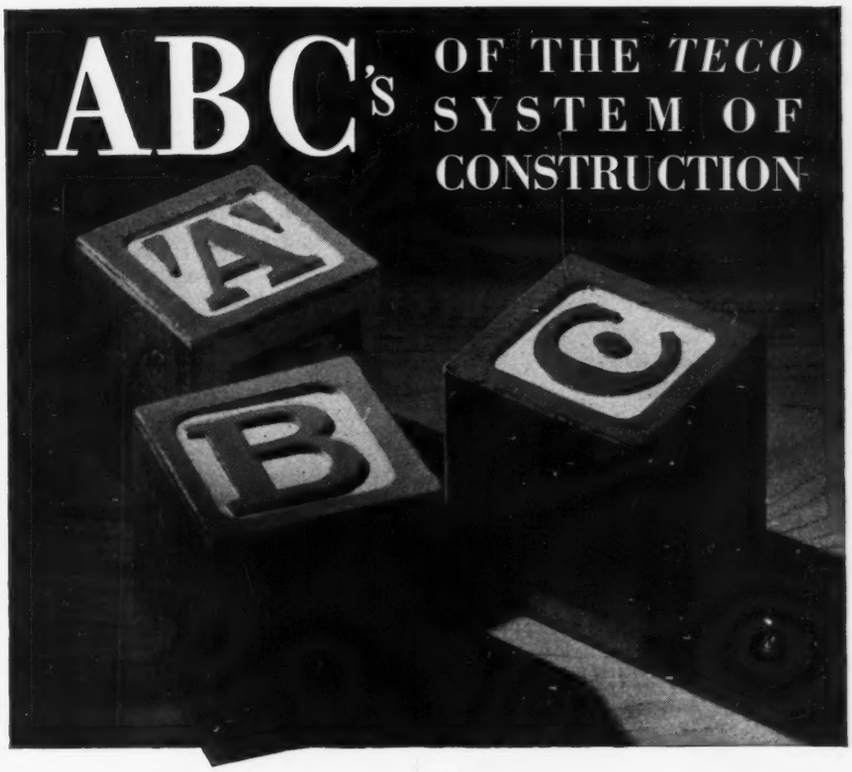
ARKANSAS

Zinc and Manganese Deposits Being Developed

Substantial increase in output of both metals is expected during 1942

▶ A greater zinc production is expected in northwest Arkansas in 1942, due to price advances. Three mills are now in operation, a fourth mill is to start soon, and several other mills are anticipated. With 9,000 acres under lease, the Manda Corp., one of the largest in the Southwest, continues leasing ground. Leases being made are along the St. Joe fault.

L. A. Watkins, president of the M.&A. Railroad, states the northwest Arkansas



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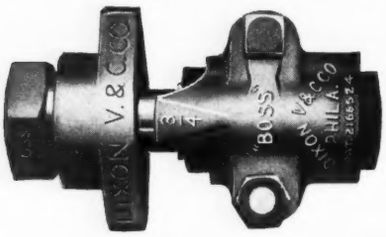

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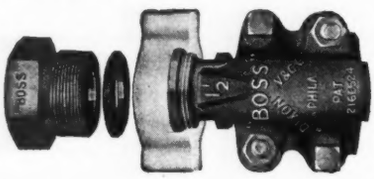

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ARKANSAS

field is badly under-financed. There is plenty of ore, but the money is not available to equip the mines properly for maximum production.

▶ Dr. R. L. Smith, president of the Smith Mining Co., announced early in January that his company is planning to erect a plant soon for recovering manganese near Russelville, Ark. The plant will treat Arkansas manganese ore and will have a capacity of five tons per day. Troy W. Carney, chemist for the company, has developed a new process of beneficiating low-grade manganese ore found in Arkansas. The company has a patent on a process for removing phosphate from the ores and has a patent pending on a process to remove silica.

▶ The Bureau of Mines which had been exploring and developing manganese deposits in the Batesville Cushman manganese field since July, 1940, stopped operations on Jan. 16. The results of its work was very satisfactory. In an area of approximately 2,000 acres, the Bureau proved more than 1,800,000 tons of wad manganese ore. About 15,000 ft. of shafts and tunnels, have been driven and prospected by, drilling 4,000 ft. with churn drills and dug some 4,100 ft. with a rotary bucket rig.

▶ In 1941 the Walter H. Denison Manganese & Contracting Co., Inc., Cushman, Ark., shipped 3,742 tons of high-grade running over 40 percent, and 2,221 tons of low-grade that averaged 28 percent. The Arkansas Manganese Co., Cushman, Ark., headed by Jack Gibbons, shipped approximately 1,800 tons averaging around 35 percent. Including smaller scattered shipments the field produced approximately 8,000 tons last year.

▶ Manganese Incorporated, a new concern headed by Donald Frazier, of Sioux City, Iowa, recently purchased the Sims Bros. Cushman, Ark., holdings in South Stone County, consisting of 425 acres, and is moving in modern mining equipment to start active operations. H. B. Cooper, operating manager, has his office at Mountain View, Ark. Shipments will be made by rail from Guion, Ark., about three miles from the mines. They will produce both carbonate and oxide ores.

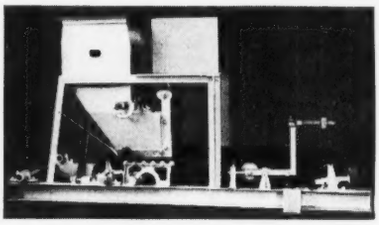
CANADA

Removal of Tariff on Zinc Concentrate Expected

Exports of Dominion zinc to United States will increase—Drilling program at Steep Rock Iron Mines continues

Removal of the tariff on zinc concentrates has been recommended by the joint United States-Canadian committee on war production and the new ruling is expected to take effect sometime in February. The action may be followed by tariff cancellation on other war materials, which would tend to boost exports from the Dominion and at the same time reduce the charges on her war orders. Base Metals Mining Corp., in British Columbia, and Normetal Mining Corp.,

PROPORTION BY WEIGHT



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in Quebec, would probably be the only two producers to benefit fully from such action in connection with zinc. Of the other mines shipping concentrates across the border, Waite Amulet would profit from half of the tariff saving, but there would be no change in contracts with the Metals Reserve Co. recently completed by Sherritt Gordon Mines and Golden Manitou for their new production that is to start as soon as milling equipment can be assembled. All zinc refined in Canada is signed up under contract with the supply departments of the British and Canadian governments.

▶ Late in January, as the Kirkland Lake strike entered its tenth week, there still seemed no possibility for an early settlement. Union leaders have wired Winston Churchill and the Minister of Justice at Ottawa asking that they intercede for the strikers. Demands were made to the Ontario Attorney-General that he remove some 200 Provincial police from guard duty at the eight gold producers affected by the dispute, but no action has followed these appeals. At the Wright-Hargreaves, mass picketing replaced the method of keeping three or four strikers on duty, even during the two weeks when temperatures fell to 30 and 40 below zero. Conferences have been held between Humphrey Mitchell, Canada's new Minister of Labor, and the managers of three Kirkland Lake mines, as well as with union representatives and the members of municipal councils from northern Ontario communities. No announcement has been made of progress in handling the strike as a result of these various discussions. Mine operators are ready to recognize committees of mine employees, in accordance with the collective bargaining agreements made last summer, but it seems unlikely, under present conditions, that the C.I.O. miners union will be recognized.

MANITOBA

▶ Mandy Mines, which shipped high-grade copper ore before the Flin Flon camp was opened, will end many years of idleness when Hudson Bay Mining & Smelting completes plans to mine the estimated 90,000 tons of copper-zinc ore remaining in the old workings. Mandy, a subsidiary of Tonopah Mining Co., adjoins Hudson Bay to the south. The sale of assets involves payment to Tonopah of $432,000 with an option on the remainder of Mandy's issued stock for an additional $193,000.

▶ God's Lake Gold Mines is carrying on an extensive program of exploration in the new shaft area some distance to the west of the main mine workings. The future of the mine depends on the success of the search for new ore, with present reserves good for only about eighteen months. Robert Jowsey is president and Frank Baker is mine manager.

▶ Production at San Antonio Gold Mines has been stepped up from 333 tons to 525 tons daily. D. J. Kennedy is mine manager and Barclay G. Anderson assistant.

▶ The Sherritt Gordon mine, 40 miles northeast of Flin Flon, is installing mill equipment for the production of zinc concentrates for shipment to the United

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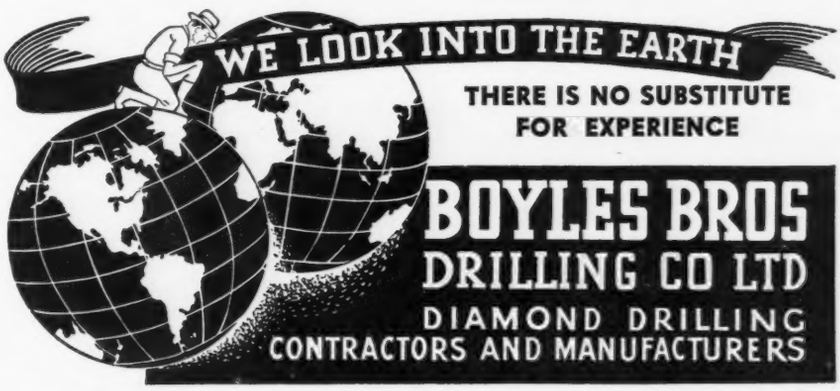

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States. This follows negotiations with the Metals Reserve Co. for the sale of zinc which, in the past, has been discarded with tailings from the copper concentrator, amounting to about 25,000,000 lb. of zinc annually. Halstead Lindsley is president and Thayer Lindsley, vice president. Eldon L. Brown is general manager.

▶R. Lennox, secretary-treasurer of Lithium Corporation of Canada, reports plans for building a salts plant for the recovery of lithium from amblyonite ore. Indicated ore amounts to 3,353 tons, in addition to spodumene ore estimated at 50,000 tons per 100 ft. depth.

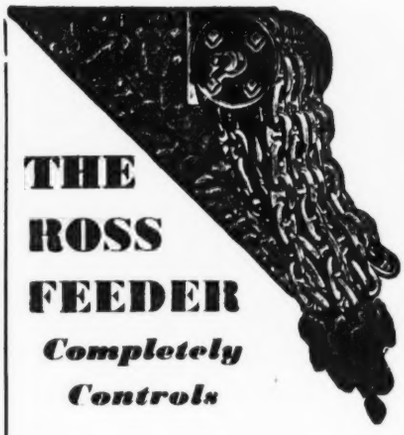
ONTARIO

▶Cline Lake Gold Mines, a subsidiary of O'Brien Gold Mines, reports operating profit reduced to $4,063 for the first nine months of the year, compared with $54,995 in the same period of 1940. In spite of higher tonnage there was a reduction in gold content and total operating costs were higher. Unfavorable results have been found at depth on the main zone, but two short shoots of good-grade ore have been opened in the west zone above the fourth level. M. J. O'Shaughnessy is mine manager.

▶Large plant increases are nearing completion at the metallurgical works of Chromium Mining & Smelting Corp., at Sault Ste. Marie. This expansion program has been made possible by five years of test work on the utilization of domestic ores for the production of chrome alloys. Using concentrates from mines in the Eastern Townships of Quebec, the new plant will soon be operating at capacity. Leo H. Timmins is president and M. J. Udy is vice president in charge of research and technology.

▶Steep Rock Iron Mines is ready to complete financing arrangements with Cleveland interests as soon as the final decision is given by the Dominion Government on the policy of taxation to be applied when the mine reaches the production stage. After an intensive study of production problems by engineers, it has been agreed that $5,500,000 will be the maximum amount required to drain Steep Rock Lake, divert the flow of the Seine River, develop power, and strip the orebody, including working capital to start shipping the ore to railhead terminals at Port Arthur. Efforts are being made to secure taxation on a basis competitive with high-grade iron producers in the Upper Lakes region. The drilling program that has been in progress for the past year continues with eight diamond drills in operation, testing both the A and B orebodies. Joseph Errington is president, M. S. Fotheringham mine superintendent, and Eldon L. Brown consulting engineer.

▶A 200-ton concentrator is to be installed at the Ontario Nickel property, near Sudbury, the concentrates to be shipped to a near-by smelter. Harry Porteous, managing director, reports that a contract is being arranged with the Ontario Hydro Commission for electric power.



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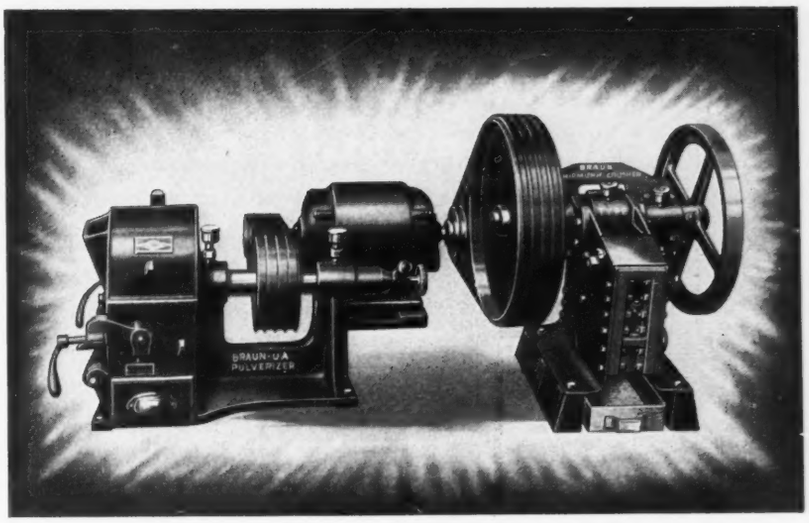
BRITISH COLUMBIA

▶ Hon. Herbert Anscomb, Minister of Mines for the Province of British Columbia, issued the following statement at the beginning of the year. "The gross value of mine production for the past year is estimated to be approximately the same as for the record year of 1940, or $75,000,000. It is anticipated that when final returns are received lode-gold production will be slightly lower than in the previous year. Placer-gold production, however, is estimated to be somewhat greater and, therefore, the total gold production will probably be about the same for 1941 as for 1940, or between $23,000,000 and $24,000,000. Dividends paid in 1941 will be about the same as in the previous year, or about $14,500,000. It should be obvious by now that gold, which in the early stages of the war was looked upon as a strategic mineral in that it creates necessary foreign exchange, is now, as we approach a total war, gradually losing some of its importance. The demand for labor to produce the tools of war, which are made chiefly of metals, is bringing more and more to the front the importance of the base-metal mining industry, and also mining of minor or strategic minerals. Though there may be reported shortages of certain metals in the United States, and we have potential supplies of the minerals from which they are extracted, we must not forget that the ability to produce ores and concentrates is dependent not only on having the necessary reserves but upon available smelting capacity and mining machinery and equipment. There is no doubt that control by means of priorities will divert mining equipment and machinery to those branches of the mining ndustry which are producing the metals most needed. This applies particularly to the development of new properties and the reopening of old properties. Copper, once the backbone of the mining industry in British Columbia, and which in recent years has fallen into third and fourth places, is one of the most important war metals and increased production in British Columbia is desirable.

"Attention should be paid to deposits containing chromium, manganese, mercury, molybdenum, tin, tungsten, vanadium, fluorspar, graphite, mica, quartz crystals, and Iceland spar. It may not be possible to mine deposits containing all of these minerals at present in this province, but the day may not be far distant when economic factors will no longer govern the mining of some strategic-mineral deposits. We must do what we can at present to prepare for future possibilities. The control of war metals is in competent hands and I would ask the public at this time to pay attention to the requests of the authorities in Ottawa who are fully conversant with the international situation."

▶ When announcement was made, some time ago, that a plant was to be erected by Consolidated Mining and Smelting Co. of Canada, Ltd., for the production of magnesium, it was thoueht that it would be in the West Kootenay district and adjacent to that company's many other plants. Now, however, it has been learned that the proposed plant is to be erected elsewhere.



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MEXICO

Mine Labor Situation Remains Mixed

Strikes continue at some properties, while organized labor seeks cooperation for a longer working day to increase output for defense

▶ Some betterment was noticeable in the Mexican mining industry with the advent of 1942, chiefly in the form of good will manifestations by the workers, though labor troubles continue, and moves by the government to aid the business in the form of modifying the mining and tax laws. This improvement is expected to continue with the increasing cooperation of Mexico with the United States in this war emergency.

▶ Organized Mexican labor, with the miners leading, have asked President Manuel Avila Camacho to order an amendment to the federal work law to legalize the 9-hour work day. The legal daily work term is now 8 hours. Labor says that the longer working day will be an important contribution to the attainment of the presidential desire for increased production. Presentation of this proposition has blocked bills in Congress, some sponsored by the miners, demanding that the Mexican standard work day be cut to 6 hours but with the 8-hour wage. The 9-hour work day is expected to be legalized this winter. Request for the longer work day is in line with Mexican labor's pledge of complete cooperation with the government in this war stress. The national miners union was the first to make this pledge.

▶ Cia. Minera The Golden Girl, S.A., operating in Nayarit, is faced with a strike to enforce demands for a general 15 percent pay increase. The workers argue that the company can well afford to meet this demand as it has been paying good dividends. The company contends that it cannot raise wages, because it does not always enjoy profits. The labor ministry is seeking to settle this conflict as it did those that affected Cia. Minera Chihuahua, S.A., Chihuahua, which ended with the making of a contract allowing a general 10 percent salary raise.

▶ Mining is closely watching the evaluation that began on Jan. 5 by experts appointed by the United States and Mexico of the properties of the expropriated oil companies, in accordance with the settlement of difference agreements that were made at Washington last Nov. 19.

▶ The Federal Board of Conciliation and Arbitration held illegal the short strike against Cia. Mexicana de Explosivas, S.A., Dinmatia, Durango, producer of much of the explosives used by the mining industry, this is being fought by the workers of this company with a suit in the National Supreme Court to upset the ruling. The board held that the strike was illegal and gave the employees 24 hours to get back to work, an order that was obeyed. The workers declare that they were justified in going on strike to enforce demands for higher wages because, they say, their present pay is inadequate for high living costs.

▶ A new contract settled labor difficulties for Cia. Minera de San Jose, S.A., La Colorado, Sonora, Apartado Postal No. 63, Nogales, Sonora, with the granting of a 5-percent pay raise and some other concessions.

▶ Regulations governing the federal mineral reserves and their exploitation are being revamped by the Ministry of National Economy. Among provisions that will be dropped is the one which demands that concessionaires of gold placer and tin deposits must personally exploit these tracts. It has been found that this demand forces the idleness of many of these tracts because the franchise holders lack money and technical facilities for exploitation. The amended regulations are expected to be put into effect late this winter. Changes in these regulations are the result of numerous complaints from mining men interested in working the reserves.

▶ Boleo recently smoothed over labor difficulties by allowing a 10 percent pay increase. The national miners union is opposing the proposition to cut wages.

SOUTH AMERICA

Argentina Will Explore Her Mineral Resources

Private enterprise to be encouraged by the government to develope metal and non-metallic deposits

▶ A campaign has been launched in Argentina to explore and develop the country's great mineral wealth. The government has been asked to encourage and cooperate with private enterprise in the exploitation of known deposits of a long list of metals and minerals vital to industry.

▶ Argentina is already producing tungsten, mica, asbestos, fireclay, barium, beryl, bismuth, borates, feldspar, fluorite, magnesium, manganese, ocres, potassium, vanadium, wolfram, china clay and molybdenum. Many of these minerals will help to fill increasing needs of domestic industry, but, according to a decision of an inter-ministerial committee of political economy their exportation will be allowed under special permit. An arrangement has concluded recently whereby the United States has agreed to purchase up to 3,000 tons a year of Argentina's production of tungsten ore and concentrates for the next three years.

PAN-AMERICAN CONGRESS

(*Continued from page* 108)

over by Ing. C. Salazar. Short abstracts of more than six papers were read and discussed by various members. These included "Thirty-five Years of Flotation," by A. K. Burn; "Separation of Minerals by the Sink-Float Process," by O. B. Hundley; B. L. Johnson's paper on retreatment of concentrates at Braden; and "Pequenas Plantas de Cianuracion a Base de Trapiche," by B. Maureira.

The non-metals section, headed by Dean Steidle, heard "The Heat-Treatment of Refractory Materials," by Hefon and

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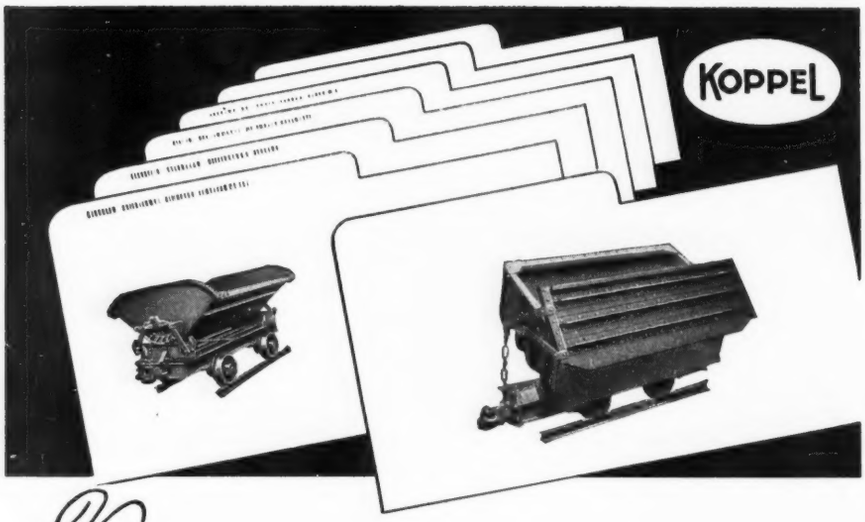

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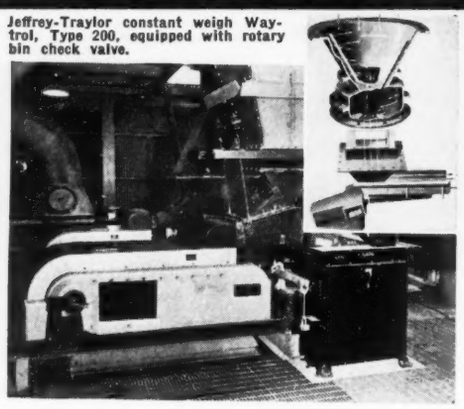
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▶ PAN-AMERICAN CONGRESS

Taylor; W. A. Weryl's monograph, "The Fining and Decolorizing of Glass"; and "Flocculation and Deflocculation of Mineral Colloids," by E. C. Henry. W. Fuchs' "A Thermodynamic Analysis of the Formation of Coal and Oil"; "Granulometria de Loes," by M. Codoni; and "Evaluacion de Posibles Campos Petroliferos," by S. J. Perso, were among the papers discussed by the geological commission. A good attendance was observed at the remaining commissions. The sessions closed with the showing of a film on the nitrate industry of Chile, and a banquet offered in the evening by the Ministro de Fomento, Sr. Merino Reyes.

During the short Saturday morning session the geological, political, mining, and milling commissions again drew a good attendance. Several excellent papers, including "El Puente del Inca, Su Conservacion y Formacion," by E. Kittle; "Pleistocene Gladiations in Colombia," by V. Apperhein; and "Nota Acerca de la Influencia del Clima en la Morfologia de los Alrededores de Arequipa," by C. Nicholson, were read and discussed. The Mining Commission discussed ore reserves, and heard R. Fritis' paper "La Produccion de Mercurio en Chile;" "Operaciones de la Cotopaxi Exploration Company," by O. W. Jarrell; and "Recent Improvements in Health and Safety Practices at Potrerillos of Andes Copper Company," by Charles M. Brinckerhoff. Papers discussed by the Milling Commission included "Beneficio de Precipitados Auro-Argentiferos de la Caja de Credito Minero," by D. Rojie; "Planta de Cianuracion de Elisa de Bordos," by G. Alamos; and O. Walker's monograph. "In fluencias del Agua Salada en el Beneficio de Minerales de Oro y Cobre."

Milling

Commissions well attended during the Monday sessions included milling, mining, mining policy, geology, fuels, and mining education. The Non-metals Commission read papers which included "Estudio de las Arcillas," by P. Krassa; "Las Sales Potasicas en las Aguas Subterraneos del Norte de Chile," by Krassa, Dietsch, and Vega; "Kieselguhr y su Applicacion en las Construcciones," by Y. M. Gavin; and "Inventario de Reservas Minerales Non-Metalicos en Chile," by B. Leiding. Some 15 papers were analyzed and discussed by the Geology Commission, including "Cobalt in Chile," by H. Hornkohl; "Tin Deposits of Colquiri," by C. O. Ferreira; "Copper Deposits of Amolanas in Copiapo," by J. L. Cortez; "Geology of the Wolfram Deposits in Bolivia," by F. Ahlfeld; "Wolfram in Argentina," by V. Angelleni; "Copper and Gold Deposits in Chile," by H. Flores; Luther Yantis' monograph describing the geology of divers mineral deposits in Equador. Among the papers read by members of the Mining Education Commission were "Extension de las Principales Industrias Minerales," by H. B. Northrup; "Trabajo Sobre Ensenanza," by F. Lastra, and "Rumbos y Objectivos de la Ensenanza de la Industria Minera," by E. Steidle. The Milling Commission studied and dis-

cussed "Trapiches de Andacollo," by Hevis, Neuenschwander, and Peña; "Minercao e Metalurgia no Municipio de Ouro Preto," by Ferrari and Barbosa; "Control Economica Grafico de los Procesos de Beneficio en las Plantas de Concentracion," by M. Silbermann; "Cuadro de Costos en las Faenas Mineras," by Neuenschwander and Waisbluth; "Control Estadistico de Planteles de Preparacion Minerales con referencia Especial a la Preparacion Carbonifera," by D. Michel, and abstracts of seven others. The Mining Commission read C. Oroza's monograph, "Muestreo de Vetas Anchas con Valores Diseminados de un Metal Until," followed by one by the same author on long-hole drilling practice at the Colquiri tin mines in Bolivia, and "Investigacion Cientifica en la Tecnica de la Industria Minera," by G. Bilbao la Vieja.

A banquet was given that night by the Corporacion de Fomento de la Produccion at the Golf Club Santiago.

Mineral Exports

While the Geology, Political, and Nonmetals Commissions continued their study and discussion of papers, the remaining commissions prepared conclusions and recommendations for presentation at the joint sessions. The Geology Commission read and discussed "Los Afloramientos de Geologia Economica," by J. Broggi, "Reglas Locales para las Vetas de Oro de los Distritos Mineros Abastecedores de las Plantas Domeyko y Carrizallo de la Caja de Credito Minero," by A. Schwarze; "Diferenciaciones Secundarias en los Yacimientos Auriferos," by Marin Rodriguez, "Los Dedimentos Prepampeanos del Valle de Nono, Argentina," by A. Castellanos, and others, and E. Munoz M. gave a brief talk on the geology of metal and mineral deposits in the northern zone of Chile, particularly between Arica and Chanaral. Shortly after the afternoon session all commissions met in joint session at the University of Chile, with Marin Rodriguez in the chair.

Following the reading of telegrams from the executives of twenty-one American Republics accepting honorary presidency of the First Pan-American Congress of Mining Engineering and Geology by Secretary Albala, the presidents of 14 commissions presented recommendations and resolutions for study, debate, and approval. The formal banquet given at the Club de la Union by the Sociedad Nacional de Mineria closed the proceedings of the day.

The Mining Commission heard brief talks on mining, production, and exports of metals and minerals in Argentina, Bolivia, Mexico, Honduras, and Nicaragua. Ing. V. Angelelli spoke for Argentina, Ing. G. Bilbao la Vieja for Bolivia, and Germán Garcia for Mexico. The papers on Honduras and Nicaragua were read by the secretary. All proceedings closed after competition of the second joint session held in the main assembly hall of the University of Chile, at which recommendations and proposals by the different commissions were read by the respective presidents and subsequently debated and approved by the assembly. In the evening a concert of Chilean music was given at the Teatro Municipal. The second Congress is scheduled to be held in Rio de Janeiro sometime during 1943.

Screening Facts

NOT JUST CLAIMS

● Preparation and concentration plants throughout the Mining Industry all agree that their screening equipment is the heart of their plant and to produce profits, must function efficiently. Simplicity Gyrating Screens do fulfill this requirement. The best proof of this fact is that over 1300 operating plants, each having from one to forty-six Simplicity machines, are on our list of known users.

One large producer, operating 15 plants in five different states, purchased their first Simplicity screens in 1929, and up to December 1st, 1941, had purchased a total of 104 Simplicity Gyrating Screens. Twenty-two of these units were purchased during 1941, with the bulk of them going into two of their newest and largest plants. Their purchases have ranged from 2'x3' singles to 5'x12' triples. During twelve years of operating Simplicity screens under all conditions, their records show a remarkably low average yearly maintenance cost per machine.

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ENGINEERING & MINING JOURNAL

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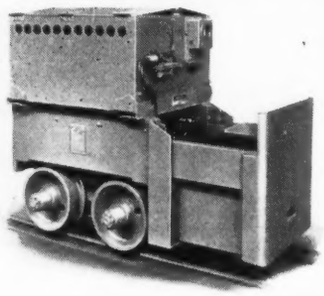
the practical side of mining—**BY ATLAS**



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Mine Equipment

(*Continued from page* 98)

by the LaPlant-Choate Mfg. Co., Inc., of Cedar Rapids, Iowa, and cable controlled scrapers, by R. G. LeTourneau, Inc., of Peoria.

MINE VENTILATION—Increased copper output at the Magma mine, in Arizona, also brought an expansion in its requirements for cool air in the deepest levels. Three new centrifugal refrigerating machines of the Carrier Corporation, Syracuse, N. Y., were installed in 1941. This extension is the third made at this mine since the first installation in 1937 and provides for air conditioning to the 4,600-ft. level.

ELECTRICAL — Use of electrical equipment in all branches of the metal and non-metallic industry ranging from electric eyes controlling electric hoist operation to recovery of important metals by electrolytic methods indicates the rapidly growing trend in the field. The General Electric Co., Schenectady, N. Y. reports that improved control for large mine hoists was made possible by the amplidyne exciter. This new system represents the first major improvement in d-e mine hoist control since the magnetic contractor-relay system replaced the simple hand-operated generator-field rheostat. One unit was installed at a large iron mine during the year. The company is reported finding a growing acceptance of its Tri-Clad motor announced in 1940 for underground use as well as in ore-dressing plants. This line of motors was extended in size and variety and now includes both open and splash-proof construction with the latter type up to 15 hp. Tri-Clad ratings now reach 150 hp. 3,600 r.p.m. Mechanical modification such as round frame, face- and flange-type endshields, vertical motors, and gear motors were made during the year. For the control of direct-current motors from alternating current lines there was introduced a new electronic motor-control system known as the Thymo-trol, consisting in its simplest form of an electron-tube control panel, a transformer, and a push-button station.

Air-cooled transformers that require no special vault construction, as they are fire- and explosion-proof, was announced by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. These units are especially adapted for mine use because of these features as well as being light in weight, of small dimensions, and easy to haul to places underground. The company also brought out a new a.c. adjustable speed drive for small vertical mounted motors.

For outdoor use on distribution systems, a new line of smaller lighter transformers was also announced by

Westinghouse. These new units have cores made of Hipersil, a new magnetic steel which has a flux-carrying capacity about one-third greater than ordinary silicon steel. These transformers are in sizes from 1½ to 500 kva., and for voltages of 2,400, 4,800, and 7,200.

During 1941 the Ohio Brass Co., Mansfield, Ohio, developed its Type GM gas-proof distribution box that facilitates the making of connections, especially in gassy areas in coal mines. It is said to be a foolproof device which makes it impossible for the operator of machinery at the face to make a connection improperly to the wrong fuse or to make a connection or change a fuse when the power is on. The company also added a three-conductor flat type 80-amp. plug, and a six conductor 80-amp. flat-type plug to its "Mechanco" line. To make connections to bond, cable, or rail for small machinery, a new junior plier-type ground clamp was also designed.

MINE SAFETY—Extra vigilance must be observed by mine operators and miners in 1942 to keep lost time due to accidents at a minimum. Every available man-hour is needed for the output of base metals, and serious consideration and use of the large supply of mine safety equipment is vital to eliminate hazards to workmen in all branches of the industry.

Among new products introduced by Mine Safety Appliances Co., Pittsburgh, Pa. were the M.S.A. ear defenders, and a single-filter Dustfoe respirator. The E. D. Bullard Co., San Francisco, introduced its new airline hard-boiled hat and a protective plastic insole for rubber boot and shoe-puncture resistance.

MISCELLANEOUS — A high-pressure spiral packing with the outer layer impregnated with a lubricant forced into the packing by a special hot-pressure process was announced by Greene, Tweed & Co., New York, N. Y.

The Lufkin Rule Co., Saginaw, Mich., brought out a new line of engineers' pattern Chrome-Clad steel tapes, all being only ¼ in. wide with marked feet 10th, 100th, and feet inches and 8ths.

Automatic boltless ball grip pipe couplings to assure quicker pipe installation were announced by The Dillon Co., Tulsa, Okla.

An oil-reclaiming unit for use in industrial plants to remove dirt from oil used in combustion engines, electric motors, automatic tool machines, etc., was announced by the Gale Oil Separator Co., Chrysler Bldg., New York, N. Y.

A new bench-type cap crimper machine that makes two smooth continuous internal beads on the throat of the cap was announced by E. I. duPont de Nemours & Co., Wilmington, Del.

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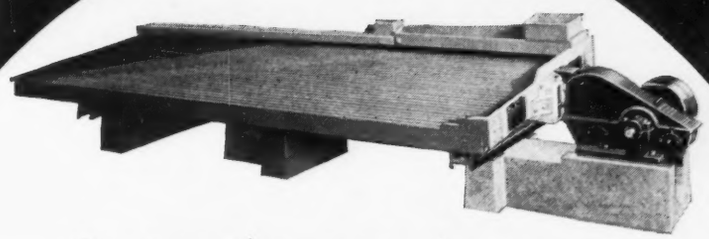

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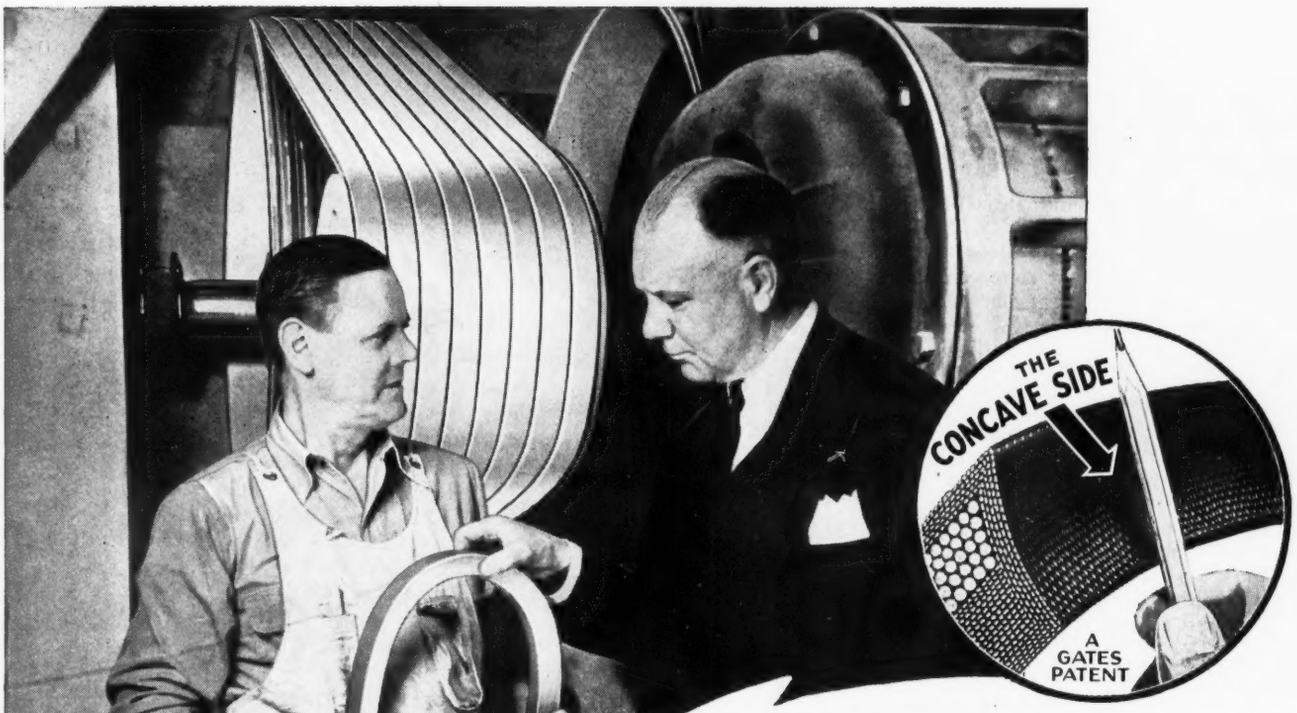

This Simple Test Shows Why the CONCAVE SIDE Cuts Belt Costs!

What Happens When a V-Belt Bends

FIG. 1

FIG. 2

If you care about belt costs, pick up any V-belt you have handy and make this simple test:—

Bend the V-belt while you grip its sides and you will feel how the belt changes shape. The top, under tension, narrows. The bottom widens. The sides of the belt bulge out. Clearly, if its sides were straight to begin with, the bent belt is forced into a shape that does not fit the sheave groove—as shown in figure 1, on the left.

Now, bend a V-belt built with the patented Concave side. You get the same shape change, but now the new shape exactly fits the sheave groove—as shown in figure 2. There is no side-bulge. Results? (1) Uniform side-wall wear—longer life! (2) The belt gets a full side-width grip on the pulley—carries heavier loads without slippage. This cuts belt costs and saves power.

Only belts built by Gates are built with the Concave side, which is a Gates patent.

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Tests With Liquid Oxygen Explosives

LIQUID-OXYGEN EXPLOSIVES are ordinarily made from a carbonaceous absorbent and form liquid oxygen of high purity. These explosives have a limited but definite field of usefulness; their properties have been described in the literature. It seems generally conceded that the outstanding hazards in the use of these explosives are their high inflammability and their relative sensitivity to mechanical action. Each of these topics has been studied, and some interesting practical results have been obtained. Treatments have been described that render liquid-oxygen explosives prepared from granular carbonaceous absorbents practically immune to the action of igniting agents representing or exceeding practical hazards in violence.

Unquestionably, the application of such fire-retardant treatments will increase greatly the safety of handling these explosives. However, certain residual hazards remain inherent in all explosive systems. This fact may not be generally appreciated in the field. For this reason and by further reason of the current application of fire-retardant treatments, it seems timely to present the results of further tests, made under mining conditions.

The present tests corroborate the work described in Bulletin 429 by showing that small and large practical cartridges of L.O.X., treated in accordance with the recommendations made in the bulletin and tested in the open, prove virtually immune to practical igniting agents and to many agents exceeding these in violence. The tests extend the earlier work by indicating that some marginal ignitions may be produced with large charges by extreme measures and that, by the action of exceedingly violent igniting agents, stemmed charges of these and other noninflammable explosives in drill holes can be ignited and made to propagate a reaction that may develop into detonation. The results emphasize the fact that although practical immunity to ordinary igniting agents can be conferred by fire-retardant treatments, the treated explosive remains an explosive and possesses inherent ignitibility, as well as the capability of propagating low-order reactions and of transforming such reactions into detonation.

Materials and Apparatus — The L.O.X. studied was prepared from a commercial granular carbonaceous absorbent, liquid oxygen of high purity, and canvas bags. The absorbent was used either as received (containing about 5 weight-percent water), moist (containing about 20 weight-percent water), or treated with an aqueous solution of orthophosphoric acid (giving either about 15 or 20 weight-percent H_3PO_4 with a ratio of dry, untreated absorbent to water near 3). The liquid contained over 99 mole-percent oxygen. The bags were of triple-filled, 10-oz. English tubular canvas $6\frac{3}{4}$ in. in diameter and 22 in. in length, and they were used as received or initially impregnated with a 20-percent aqueous solution of diammonium phosphate and redipped in this solution either before or after soaking in liquid oxygen.

A free-running ammonia dynamite containing principally ammonia nitrate and about 8 percent nitroglycerin was studied in parallel tests; this was used either loose or in the canvas sacks $6\frac{3}{4}$ in. in diameter and 22 in. in length.

Two types of igniters were employed: A large igniter made with a double thickness of the canvas $6\frac{3}{4}$ in. in diameter and 10 in. in length, packed with kieselguhr and soaked in liquid oxygen, and small igniters $1\frac{1}{4}$ in. in diameter and about 5 in. in length made with a double or triple wrap of the canvas and the same inert absorbent similarly soaked. Primary initiation for these igniters and for other tests was afforded by a safety fuse that had been slit lengthwise about 1 in. near its end; absorbent cotton was wrapped round the slit to prevent loss of powder and to increase the incendivity. Other initiators included cigarettes employed either singly or in bundles and soaked in liquid oxygen, bundles of matches, 60-amp. electric fuses, a hydrogen-oxygen flame, and incandescent rivets.

Washed *ripio* (leached tailings from the extraction plant) was used for stemming, either loose or in canvas sacks $9\frac{1}{2}$ in. in diameter and 2 ft. in length tied in the center. Wire leads were used for handling the cartridges in 8-in. drill holes 50 or 60 ft. deep in granodiorite.

A lever device was used for applying igniting agents, such as lighted cigarettes, to unconfined cartridges from a distance. Special equipment was employed for firing the electric fuses in a few tests.

Apparatus and samples similar to those used at the Bureau of Mines were employed for small-scale tests.

Procedure—In tests of large unconfined cartridges one or two cartridges (in contact) were placed on the ground with their long axes parallel and with the igniters or igniting agents on top. The time of evaporation before testing was 30 minutes in tests with the large igniter. Tests were made with the small igniter, cigarettes, matches, fuses, flame, and rivets after both 5 minutes and 30 minutes of evaporation.

In tests in drill holes two cartridges were placed at the bottom of the hole with the large igniter between them; 9 sacks of ripio (giving a column about 8 ft. high weighing 185 lb.) were used for standard confinement; and all tests but one were made after 15 minutes of evaporation, the time of evaporation being 30 minutes in the exception.

The general procedure was firing or application of the igniter or igniting agent and observation of the result.

Results—Initial small-scale tests of the treated L.O.X. and of the ammonia dynamite using the hydrogen-oxygen flame showed them to be noninflammable; they could not be inflamed and would not sustain or support combustion. Tests using small quantities of the explosives and incandescent rivets gave similar results. Some combustion was induced at the points of contact with the rivets, but usually it was arrested spontaneously immediately upon removal of the rivet. No differences were noted in the behavior of the two explosives.

Similar tests were untreated L.O.X. resulted in deflagrations.

Tests of unconfined $6\frac{3}{4}$ by 22-in. L.O.X. cartridges — No ignitions resulted in 33 tests of the treated L.O.X. employing cigarettes applied singly or in bundles of five; bundles of 40 safety matches; cotton-wrapped slit safety fuse; incandescent rivets; and small igniters made with a double wrap of canvas. One short-lived local sparking and one very slow ignition followed by a sparking combustion that consumed about three-fourths of the cartridge resulted in tests with two of the violent small igniters made with a triple wrap of the canvas.

After some delay subsequent to firing, slow sparking combustions were obtained in four or five tests with the treated L.O.X. and the large igniter; these combustions centered around individual aggregates of particles and were usually arrested spontaneously after about one-half hour with a great portion of the cartridges left unburned.

Similar tests with untreated L.O.X., prepared from canvas as received and from the absorbent either as received or moist, resulted in violent deflagrations.

Tests in drill-holes of $6\frac{3}{4}$ by 22-in.

L.O.X. cartridges and of an ammonia dynamite—With the treated L.O.X. deflagration resulted in three trials from ignition by the large igniter of charges consisting of two unstemmed cartridges in drill holes; a fourth deflagration, which was relatively mild, resulted under similar conditions with 20 lb. of loose ripio stemming. Under similar conditions, but with the standard stemming added, four detonations resulted; on the average, 3 minutes elapsed between firing and the first appearance of smoke, and combustion persisted rather quietly for about 2 minutes before detonation.

With the ammonia dynamite, two deflagrations lasting 15 and 25 minutes were induced by the large igniter placed in the center of charges consisting of the loose contents of two 6¾ by 22-in. cartridges confined with the standard stemming. Two detonations followed combustions lasting 4 and 5 minutes that were induced by the large igniter placed on top of the contents of one cartridge and beneath the second cartridge, left in the bag, and the stemming.

In tests with 60-amp. electric fuses, firing at 150 amp. and 220 v. in the center of the loose contents of two 6¾ by 22-in. cartridges of dynamite stemmed with one sack of ripio gave a deflagration; only slight chars appeared on the wrapper of treated L.O.X. tested with the fuse around the base of the upper of two cartridges and with the same stemming, when the fuse was fired at 180 amp. and 500 volts.

Conclusion — These tests emphasize the importance of the scale of test and of practical confinement on the behavior of the noninflammable explosives considered. The numerous tests in the open, with many violent igniting agents and small or large cartridges or small quantities of the treated L.O.X. or ammonia dynamite, showed them to be noninflammable. With large practical cartridges of treated L.O.X. in the open, some propagating reactions were induced by the most severe igniters employed. With these large cartridges of either the treated L.O.X. or the ammonia dynamite in drill holes some detonations resulted from inflammation by large igniters; however, these detonations occurred after delays and warnings that would have induced nearby workmen to leave the danger area.

Although these data corroborate the earlier indications that virtual immunity to practical hazards of ignition may be conferred upon L.O.X. by fire-retardant treatments, they also emphasize the fact that the potentialities common to all high explosives remain as long as such treatments do not destroy the explosive properties of the system. Furthermore, despite the extreme measures employed to induce inflammations in the explosives tested and despite the fact that any such violent igniting actions are unlikely to be met in the field, the occurrence of ignitions with the large charges and the development of detonations from such ignitions under practical confinement in drill holes emphasize that the recommended use of fire-retardant treatments for L.O.X. should for safety be undertaken with no relaxation in the necessary protection of these or any other explosives from hazards of accidental ignition.

Excerpted from U. S. Bureau of Mines Report of Investigation 3605, entitled "Practical Fire-Sensitivity of Liquid Oxygen Explosives Treated With Fire-Retardants," by A. R. T. Denues. The experimental work described was done for the Chile Exploration Co., of New York.

Softening Water With Non-Metallic Minerals—IV

PART I, PART II and PART III of this article, which is now completed on this page, were published in the November and December, 1941, and January, 1942, issues respectively.

Organic Anion Exchangers—Anion exchangers are similar to the synthetic cation exchangers, the main difference lying in the use of an amine derivative of phenol rather than phenol or its equivalent in the condensation. The simplest combination for an anion exchanger would be the condensation resin resulting from the interaction of aniline and formaldehyde; however, the most satisfactory anion exchangers are made with meta-phenylene diamine and formaldehyde.

The anion exchangers have passed the laboratory stage successfully and are now in commercial use. The exchange capacities are of the same order of magnitude as those of the carbonaceous cation exchangers. As the capacities of carbonaceous exchangers are being stepped up as a result of continued research, so, likewise, will those of the anion exchangers.

Recent Trends in Water Treatment —Industrial progress, creation of new industries, and technical advances in old industries have all made more exacting demands on industrial water supplies. Added to this is more-recent knowledge of the seriousness of fluorides in potable waters. This all sums up to the realization that water purification must be placed on a sounder basis if industry and the public alike are to be served well. The presence of fluorides in drinking water has made it necessary to install special equipment to remove this impurity; otherwise there will be danger of seriously mottling the enamel of the teeth. Other elements likely to be objectionable to certain special industries are iron and manganese. The modern water plant is designed to treat the water in a particular locality scientifically, so that it will satisfy both industry and the public. Coagulation alone may be inadequate, especially if the water needs softening or if the iron and manganese contents are high. In such instances the plant must be designed to remove or reduce all of the objectionable characteristics of the water. How water treatment has progressed can be attested best by the accompanying table, which gives the water-purification plants begun or completed during 1936, together with statistics on purpose of treatment, number of plants erected for each specific requirement, capacities, and population served.

Excerpted from U. S. Bureau of Mines Report of Investigations 3578, by S. J. Broderick, Southern Experiment Station, Tuscaloosa, Ariz.

Summary of Water-Purification Works Begun or Completed During 1936

Purpose of treatment	Plants, Number	Percentage of Total Plants	Capacity M. G. D.	Percentage of Total Capacity	Population Served	Percentage of Total Population Served
Purification only	119	53	657,186	85	2,792,996	83.1
Iron removal only	38	17	8,771	1	49,584	1.4
CO_2 removal only	7	3	910	0.1	5,624	0.2
Softening only	28	12	66,510	9	266,085	7.9
Purification and iron removal	1	1	500	0.1	2,523	0.1
Purification and softening	9	4	21,522	3	132,058	3.9
Purification, iron removal and softening	2	1	1,800	0.2	41,893	0.4
Iron removal and softening	16	7	8,870	1	76,541	2.3
Iron removal and CO_2 removal	2	1	3,100	0.4	22,830	0.7
Iron and manganese removal and softening	1	1	1,500	0.2	1,679	..
Total plants	226	..	770,669	...	3,361,813	..